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NOTES AND COMMENTS.

Prehistoric Man in Switzerland.

Those interested in the study of prehistoric man should read an important paper which has just appeared in the "*Nouvelles archives des Missions scientifiques et littéraires*" (vol. iii., pp. 1–25, pls. i.–iv.) In this paper M. Marcellin Boule gives a clear and readable account of the excavations undertaken by Dr. Nüesch in deposits under a rock-shelter at Schweizersbild, near Schaffhausen, in Switzerland. The explorations are particularly valuable, not only from the interest of the objects discovered, but on account of the care that has evidently been taken to note the exact conditions under which each object was found.

The highest deposit is of recent origin, and contains Neolithic and Palæolithic implements mixed pell-mell with coins, etc. Bed 2 is entirely of Neolithic age, and yields not only implements, but graves with human skeletons (nine have already been found.) It contains, also, bones of various animals, all still living in Switzerland with the exception of the reindeer, the bones of which, however, are thought by M. Boule to have been dug out of the lower strata when the Neolithic graves were excavated. Next comes a rubbly deposit, without trace of man, but containing a loamy seam full of bones of small rodents. Though this bed 3 is of great importance, separating as it does Neolithic from Palæolithic strata, we are not told what the rodents are, or whether they point to warm or cold conditions. The omission is unfortunate, for we should like to know whether any climatic change coincided with the change of races. In bed 4 the reindeer is the dominant form, and with it are found bone tools, har-

poons, and needles, hearths and traces of cookery, and worked flints of the patterns commonly found in deposits of the reindeer period. A few sketches of horse and reindeer, incised on flat pieces of bone or limestone, have also been discovered. Bed 5 has as yet yielded no trace of man, but is extremely rich in remains of rodents, like those characteristic of the extinct German "steppe-fauna" of Professor Nehring, who has also identified the specimens from Schweizersbild. Directly beneath lies a mass of rolled pebbles, forming part of the widespread sheet of flood and moraine gravel usually referred to the latest glaciation of the Rhine valley.

These excavations show that part at least of the Palæolithic deposits are newer than the last glaciation of the district. We have, however, no account of the contents of bed 3, which may possibly show a less marked recurrence of arctic conditions, such as seems to have taken place in Britain after the Palæolithic period and before the incoming of Neolithic man. The oldest types of Palæolithic implements, and the large extinct mammals, such as elephant and rhinoceros, usually associated with them, have not been found at Schweizersbild, and it is still a moot point whether they should be looked for above or below the moraine gravels which mark the climax of the Glacial period. It is satisfactory to learn that half the area under the rock-shelter at Schweizersbild remains to be excavated, so that there is still a possibility of clearing up these doubtful points. We shall watch with great interest the results of Dr. Nüesch's excavations during the coming season, after which we hope to receive a fuller report.

Early Flowering of Plants.

Now that the season has begun, we would like to suggest the advisability of a more scientific method in the observation of dates of flowering of plants. One constantly comes across notes recording the exceptionally early appearance of certain flowers. It is forgotten, however, that the premature opening of the flowers may often mean death to the plant, or at any rate a serious waste of material. The production of seed is the final end to which all parts of the plant are modified. If by early flowering the plant is enabled to seed more freely, the date of flowering will tend to become earlier and earlier; but if the flowering is premature, and is not followed by the formation of seed, then the date will become later and later, as the too hasty individuals are killed off.

Observers should not pick these early flowers, they should mark the specimens and return later on to see whether they have, or have not, produced any seed. No one appears yet to have noted whether the buttercups and dead-nettles, which flower more or less all through the winter, produce seed from the winter flowers.

The Great Barrier Reef of Australia.

In our issue for November, we called attention to the work of Mr. Saville Kent on the Great Barrier Reef, and were enabled, through the courtesy of Messrs. W. H. Allen & Co., to give a specimen plate from his remarkably interesting book. We have now received from the publishers a set of twelve beautiful enlargements in permanent photography that have been prepared for the use of Museums and Natural History Societies. These pictures, which measure 15 ins. by 11 ins., show, in a striking manner, the appearance of a coral reef at low water, and, in many instances, even the generic relation of the coral masses can be determined. From a geological or zoological point of view, these photographs will be invaluable. They are published, ready mounted for framing, at half-a-guinea each, or four guineas for the twelve.

Dredging on Rocky Ground.

So much has been written about our knowledge of the deep-sea and its inhabitants, that it is scarcely realised how little we do know. We let down a dredge or trawl at haphazard into the dark, and scrape off certain of the creatures that are to be found on the surface of the muddy bottom ; but of those that bore deeply we have no knowledge. On rocky or stony ground we have not even these small opportunities for learning what creatures live there, except the few that may be brought up by the hempen tangles ; yet in all probability it is on the irregular rocky bottom, rather than on the monotonous mud flats, that life is the most varied.

If we want to obtain some measure of the extent of our ignorance, we must put ourselves in the place of the inhabitants of the deep-sea. Let us imagine some dwellers in upper air to be anxious to learn what sort of creatures are to be found in its lower strata, or crawl about on the earth's surface, beneath the mantle of cloud and fog. An exploring balloon is sent out, with instructions to dredge carefully. The first haul is made in the dark on rocky ground—say among the houses of London. What would be the result ? The dredge would leap from roof to roof, missing the varied life of the streets below. It would bring up some slime out of the gutters, a tangled mass of telegraph wires, some weather-cocks and ventilators, broken chimney pots, a stray cat or two, and perhaps a casual burglar with his luminous apparatus.

The scientific men of upper air, asked to report on the haul, would remark on the wonderful advance that had been made in the knowledge of the deeper air, and of the customs of its inhabitants. They would reconstruct in imagination the world below, and would probably suggest that telegraph wires and chimney-pots are the snares and traps used by burglars for the capture of cats.

No doubt scientific men are very sensitive to any remarks on their ignorance; but we feel impelled to make these comparisons for their own sakes. It should clearly be recognised that the study of the habits of marine animals and of the interdependence of the various species in any fauna, needs something beyond museum work. Properly to understand the natural history of the deep-sea we must adopt a different method of procedure; we must examine the creatures alive, and under natural conditions. This has no doubt partially been done with a few of the species that will live in aquaria; but most marine animals have never been studied in the living state and cannot thrive in confinement.

Submarine Photography.

There seems, however, to be an unused method of research, which ought to yield satisfactory results, and should help us to understand what sort of life is led by the inhabitants of the deep-sea. Photography could, we believe, be used for submarine exploration without much difficulty, and we are surprised that so little has yet been done. Our ordinary photographic lenses would, of course, be useless for this purpose; but lenses to act through a denser medium could easily be made. In the second place, the pressure at considerable depths is so great that a camera of the usual pattern would not do; we must have the camera full of water, and with no air-spaces anywhere. This brings us to the last, and probably most serious, difficulty. How can the sensitive plates be preserved from injury if they are immersed in water? It could be done by laying another glass plate on the film, and photographing through glass, though this would tend somewhat to blur the image. A better way would be, if possible, to waterproof the sensitive film, and dissolve away the varnish before developing the plate.

By some such mode of procedure it is probable that we could obtain photographs as far down as light penetrates. We might even use the electric spark to illuminate the surroundings at great depths; for a hollow sealed sphere of thick glass will stand an enormous pressure. For the study of the manners and customs of the deep-sea fishes, a few sub-aqueous photographs would be invaluable. Coral-reefs also, though so carefully studied and well photographed down to low-water mark, are not understood. A series of photographs of the steep, submerged portion of the reef ought to throw a great deal of light on the vexed question of the origin of coral islands. We hope that some enterprising amateur photographer will take up this question, and begin by photographing in their native haunts the inhabitants of some of our lakes or sheltered sea-lochs.

Fruit-Growing at the Cape.

Fruit-Growing at the Cape is in an unsatisfactory way, according to Professor Macowan's account in the January number of the

Kew Bulletin. The methods of the fruit farmers are "antiquated and conservative," they lead an isolated life, and there is no effective interchange of ideas and information on the subject of their industry, nor do they care to learn what is being done in other countries, or might be done in their own. Moreover, the demand for cheap, coarse fruit among the coloured lower orders in Cape Town is a serious check on any desire for improving the output. "So that the grapes are dirt cheap it does not matter to them how dirty they are, nor are they disgusted at seeing the same baskets that carried the grapes into town piled up among the stable manure the cart takes back to the farm in the afternoon." So little is quality thought of that the producer can grow saleable crops from seedling trees fit only for stocks. "Upon the very few enlightened men who grow fruit on European principles, of the best sorts and in the best manner, the stolid indifference of the market and its pernicious ring of half-coloured middlemen reacts with cruel force. They cannot, somehow, reach the educated purchaser who wants fine and clean fruit, at its best maturity, fit for dessert." This is a sad state of things, and, moreover, the Professor tells us, it is the same with fish. "We all have to be content with what suits the Malays, dispensed Malay fashion." What a chance for someone, with a little capital and patience, to grow and retail his own fruit, and break this vicious circle of middlemen. According to Mr. William Tuck's report from Grahamstown, the growers are quite as casual in the Eastern Province.

The seasons on the two sides of the colony are differentiated, much as in India, by the rainfall occurring conversely, the west having its maximum in winter (June to August), while the east has generally two maxima in the warmer months, November or spring rains, and February or autumn rains. These peculiarities are important in fruit-growing, wine, grape, and raisin production being limited to the Western Province, where alone the summer is sufficiently hot and dry for the proper ripening of the fruit.

Atropin as a Plant Manure.

In a recent number of the *Revue Générale de Botanique*, M. Henry de Varigny describes some experiments on the value of the alkaloid atropin as a plant manure. Goppert (1834) was apparently the first to test the action of alkaloids in general, and atropin in particular, in this connection. He found the result to be the same whether he watered the earth, in which wheat, peas, oats, or cress were sown, with pure water or an infusion of belladonna. The infusion neither accelerated nor retarded germination.

P. B. Reveil (1865) came to a different conclusion. He used a solution containing a known quantity of the soluble sulphate of atropin, and found that it favoured the germination of barley sown

in calcined and washed sand. Moreover, for some plants, he does not say which, it is a "veritable manure"; when watered with a solution they were finer and more vigorous, and flowered better and more quickly than under normal conditions.

In 1887, however, M. A. Marcacci, in his "L'azione degli Alcaloidi nel regno vegetale et animale," asserts that atropin has an injurious effect on germination.

M. de Varigny has made an extensive series of experiments, growing his plants either on washed and heated sand or cotton-wool, and using solutions of the sulphate of atropin of various strengths, from $\frac{1}{15}$ to 1 per cent. Seeds of a considerable number of species were tried, wheat, barley, oats, and other grasses, cress, lettuce, radish, turnip, buckwheat, and others. In every case the experiments were checked by growing the seeds under conditions in every way similar, but without the alkaloid. As a result, he found that almost invariably there was certainly no advantage in the presence of atropin. For instance, several experiments were made with Indian cress, and in almost all the weight of the crop in the control experiment exceeded that in the others, and the greater the proportion of atropin the smaller the crop. This was equally well marked with wheat. Out of 75 seeds sown in each case, 64 germinated in the control experiment, 39 in the $\frac{1}{5}$ per cent. solution of the salt of atropin, and 41 in the $\frac{1}{15}$. In some cases, such as the beet, cabbage, lentil, buckwheat, and pea, the alkaloid had apparently no effect, germination and growth being almost the same in the two series of culture, while in the carrot and lettuce it certainly seemed favourable to growth, but M. Varigny thinks the experiments with these species must be repeated more frequently before arriving at any definite conclusion.

On the other hand, it is quite clear that there are a number of species whose germination and growth is retarded, or even stopped by the drug.

Jade in Upper Burmah.

Dr. Noetling, of the Indian Geological Survey, has issued an interesting report on jade in Upper Burmah. Speaking of the geology of jade, he says that two facts are now established—one, that jade is found in association with and enclosed in an eruptive rock closely resembling serpentine; the other, that this serpentine pierces strata of perhaps lower, but more probably of upper Miocene date. He observes that it is now proved that the jade found in Burmah belongs to a group of eruptive rocks of late Tertiary age, and as it is intimately connected with serpentine, it is probable that it will be found at other places where the latter occurs, when once the outer shell of the serpentine has been pierced. Formerly it was extracted only in the Uru Valley, where it was found in boulders in the alluvial deposits

of the river. Sometimes it was embedded in laterite, and was then particularly appreciated on account of the peculiar red crust which enveloped a core of jade. The boulders were found by digging holes along the banks of the stream, or by diving to the bottom; but recently an enterprising Chinese has imported a diving-bell for the purpose. At the quarries at Tawmaw the mode of extraction is primitive and destructive. The surface of the rock is heated by large fires, and the cold at night is sufficient to crack it without pouring on water. By using crowbars and wedges in the cracks, large blocks of jade are obtained, which are broken with mallets to make them of a size suitable for transport. This rude treatment naturally damages the stone, and therefore the alluvial jade is greatly preferred. Jade, says Dr. Noetling, is a curious example of articles highly prized by certain people, and regarded with complete indifference by others. The Burmese and the Chinese, especially the latter, value a good piece of jade as much as, if not more than, so much gold. Thus, they will pay for a piece large enough for a signet-ring 400 to 500 rupees, while the same piece sold in Europe will fetch little or nothing.

Anæsthetics and Plant Transpiration.

In the February number of the *Botanical Gazette* Albert Schneider gives an account of experiments on the influence of anæsthetics on plant transpiration. Jumelle concluded that sulphuric ether affected this function differently in the light and in the dark; in the former it was increased, in the latter retarded. The increase in the light was supposed to be due to the action of the ether on the chlorophyll bodies, while the retardation in the dark was not explained. Verschaffelt, on the contrary, maintains that ether increases transpiration both in the light and dark. Schneider claims that as these two experimenters used only parts of plants, their conclusions are of little practical value, the natural absorbent organ, the root, being absent. He himself uses small but entire plants of the potato, fuchsia, or geranium. Moreover, they may possibly have confounded *evaporation* with *transpiration*. The former—the mere passive loss of water—is much more rapid in the case of dead than living tissue, while the latter, the active giving up of water vapour, can only occur in living tissue, and is dependent upon protoplasmic activity. Prolonged contact with ether may kill the leaves of the plant under experiment and the result be confused by substitution of evaporation for transpiration.

Experiments on protoplasmic movements in the hair cells of *Primula sinensis* and other plants showed that ether vapour reduces their activity temporarily when exposed for a short time, and permanently if for a longer.

Experiments with whole plants of the potato seemed to show conclusively that exposure to the vapour of ether, amyl nitrite, or

chloroform materially diminishes the transpiration; fifteen minutes with amyl nitrite sufficed to kill the greater part of a plant, while it could withstand a much longer exposure to the other vapours. Ether and amyl nitrite reduced the transpiration both in light and dark, and the different colours of the spectrum had no effect on the influence of ether vapour. Red, yellow, and green lights were obtained by use of bell-jars, the hollow walls of which were filled with fuchsine, "diamond dye" yellow, or a mixture of diamond dye yellow and blue respectively, the conditions of temperature and moisture being constant. The average results of a series of experiments under otherwise normal conditions, showed a gradual slowing of the rate of transpiration from diffused white light, through yellow, red, and green, to darkness.

A set of experiments with the potato and a fuchsia showed that moisture did not affect the influence of ether and amyl nitrite; moreover, at no time, though the atmosphere was practically saturated, did the transpiration approach zero. Kohl, on the contrary, claims that in the saturated atmosphere it is zero.

Finally, to show the cause of Jumelle's apparently erroneous conclusions, Schneider made a series of experiments with leaflets of the potato. He found that, when exposed to ether for three hours or less, either in light or darkness, transpiration, estimated by loss of weight, was retarded, but with an exposure of 3½ or 6 hours the loss of weight increased in both cases. Owing to the long exposures, the ether had stopped the protoplasmic activity, and hence increased evaporation in both cases, but most in the dark, because in the dark the leaflets were killed earlier.

THE LANDSLIP AT SANDGATE.

SANDGATE, on the Kentish coast, was a good deal damaged by landslips on March 4 and 5, though the accounts of the mischief done have been considerably exaggerated. We are informed by Mr. Topley, who is intimately acquainted with the geology of the district, that the whole town is built on an old landslip, and that the western part of this disturbed mass has slipped again, owing principally to the exceptionally heavy rainfall experienced during the past winter. Mr. Topley will give an account of the landslip, and will exhibit photographs, at the meeting of the Geologists' Association, to be held at University College, on April 7.

TARGET PRACTICE AND FISHERIES.

FROM the Report of the Target Practice (Seawards) Committee, just issued, we observe that some interesting evidence was given by Mr. Calderwood, of the Plymouth Marine Biological Station, as to the position of favourite fishing grounds on the South Coast. The Committee say: "The evidence of Mr. Calderwood . . . . satis-

fied us that it is of great importance that the military and naval authorities should be furnished with accurate information respecting the position of the favourite fishing grounds in the localities where target practice is carried on, and of the times of tide and seasons when fishermen in the neighbourhood are ordinarily engaged upon particular grounds, and of the character of the pursuits followed. And of the gear used by fishermen at different times of the year in fishing for various kinds of fish." Mr. Calderwood has furnished to the Committee, who have reproduced it in their Report, a map showing the localities for special fish off Plymouth during the month of April. Of course, these localities vary from week to week, and it would be desirable, and no doubt important, if a large series of such sketch-maps could be published. The evidence offered as to the effect of the electric light in attracting or frightening fish is conflicting, and the same may be said of the noise of the firing of heavy guns. We note that the index shows a great improvement on the general run of indexes to Blue Books, it is really a useful *précis* of the whole Report.

Tertiary Mollusca of Florida.

We have received from Mr. W. H. Dall the second part of his "Tertiary Mollusks of Florida" (*Trans. of the Wagner Free Institute of Science*, vol. iii., pp. 201–474). This part completes the account of the Gasteropoda, and places in our hands, at last, better materials for the study of former zoological provinces. No group of Tertiary fossils has been so well examined in many different parts of the world as the Gasteropods, and by a careful comparison of the different monographs that have lately appeared, we ought to be able to obtain information as to the former continuity or isolation of the different areas. An account of the Tertiary marine gasteropods of the Pacific slope of America is still wanted. Until they have been examined, it will be difficult to speak with confidence as to the dates of submergence of the isthmus of Panama, and we also cannot deal with the possible diversion of the Gulf Stream at different epochs, and its effect on the climate of Western Europe.

Tertiary Mollusca of Piedmont.

We are glad also to observe that the splendid monograph on the Tertiary Mollusca of Piedmont, left unfinished on the death of Professor Bellardi, is steadily progressing under the hands of Professor Sacco, of Turin. Another part has lately appeared, and we may expect before long to see the completion of the gasteropods. The Tertiary molluscan fauna of Italy is so prolific, that the monographing of those found even in a single region is a herculanean task. We hope that Professor Sacco will receive sufficient encouragement and

assistance to enable him to complete the work. When will the Palæontographical Society complete the monograph on our own Eocene Mollusca, left unfinished on the death of Messrs. Edwards and Wood?

Sea Pellets.

In the February number of the *Revue Générale de Botanique*, W. Russell has an interesting note on these peculiar felt-like balls thrown up by the sea, or sometimes found on the shores of inland lakes. They occur in great abundance round the Mediterranean and seem to have puzzled the old naturalists. The Greeks knew of them, for Galen and Aristotle recommend the use of their ashes as a remedy for scrofula. Later, Constant and Cornarius placed them in the genus *Alcyon*, a group which, however, included sponges and corals as well as sea-weeds. Cesalpinius, in his "De Plantis" (1583) describes them as formed of the down of the sea, but Imperato, nearly a century later, refused to rank them as plants, more nearly recognising their true nature as "balls of chaff and hair made by the rolling of the sea," and showing that they must not be confused with the hair-balls found in the stomach of goats and other ruminants.

At the end of the last century, Draparnaud found the pellets collected on the Mediterranean shores to be composed of fibres felted round a fragment of that curious marine flowering plant the sea-wrack (*Zostera*), and, later on, Bory de St. Vincent described similar ones from the Straits of Dover.

In 1857, Germain de Saint Pierre remarks on the spherical pellets of brown felted fibres found on the coast of Provence, and used by the hunters of the district as a wad for their guns, and finds that they consist "of fibres persisting on the stems of *Posidonia Caulini* after the destruction of the leaves, of which they represent the nerves."

Weddel, in 1867, explained their formation thus: The old root-stocks of the plant are torn into shreds and broken by the continual shock of the waves, while larger fragments rolled up and down the carpet of fibres, especially where the shore forms a gentle slope, catch them up, and become the nucleus of often very large balls.

Frequently, however, the core is absent, as in many of the cases quoted by Russell from Italy, where they were usually spherical or ovoid, solidly felted and remarkably homogeneous, but sometimes fusiform with a rigid axis, easily recognisable as a fragment of the rhizome. The author goes on to describe some pellets collected in the Island of St. Marguerite, which he has found to consist of scales of pine cones in all degrees of alteration, some intact, others reduced to a few fibres, and numbers of filaments generally rather thick, and only 5 or 6 centimetres long at the most, but mingled with others long and threadlike but less numerous. In the short filaments the bordered pits and resin canals characteristic of the pines were easily seen under

the microscope, but the threads were of a quite different structure, consisting of long cells, almost all of the same form, and, according to the author, evidently belonging to a monocotyledon presumably *Posidonia*, numerous rootstocks of which occurred on the beach mixed with the pine cones. These long filaments had played the part of a thread uniting the smaller *débris*, which otherwise would probably have remained separate.

Other cases are mentioned in which the *Posidonia* fibres act in this way. Bits of sponge may form a nucleus round which they group themselves, while seaweeds may get involved. An example exists in M. Bornet's herbarium, a green alga in the shape of a ball, in which the *Posidonia* filaments are caught like pins. The latter example is comparable with the instances cited by Masters, and found in certain small English lakes, of Confervæ interlacing and forming a ball with the leaves of the larch.

These recall the so-called aegagropilous algæ, which are merely species of the green alga *Cladophora*, detached at an early stage from their support, and rolled by currents. As Russell suggests, all submerged bodies, under certain circumstances, might form similar pellets. The pine needle balls from the lakes of the Engadine are well-known, and M. Jaccart, of the Lausanne Museum, states that in a little creek in the Lake of Geneva, where the water is unceasingly disturbed by currents, fine felted pellets may be seen formed by shavings from a saw-mill.

Evolution of Premolar Teeth.

That indefatigable worker, Professor W. B. Scott, of Princeton, has contributed to the last issue of the *Proc. Acad. Nat. Sci. Philadelphia* (1892, pp. 405–444), a very interesting paper on the evolution of the premolar teeth of mammals, especially those of the Ungulates and their allies. It is clearly shown that premolars start as simple cones, and receive their first accression by the addition of a smaller cone on the inner side. It is thus evident that the protocone in these teeth is external; whereas, according to the general interpretation, in the true molars it is an internal element. Professor Scott is thus led to conclude that in Ungulates like the horse, when the upper premolars exactly resemble the molars, the various cusps of these two series of teeth are not homologous with one another. He, therefore, proposes a new series of terms for the premolar cusps.

The idea that such precisely similar teeth have a totally different origin for their cusps is sufficiently startling to make us anxious to ascertain whether the inductions on which the theory rests are well founded. Now, at the conclusion of his paper, Professor Scott mentions that Herr Röse has recently come to the conclusion that in quadritubercular upper molars the cusps have been wrongly identified, and that the protocone is, after all, external. If this be so, adds Pro-

fessor Scott, the premolar and molar cusps are really homologous, and the long series of new terms proposed for the cusps of the former quite superfluous. The obvious comment on this is *festinâ lente.*

THE EXPEDITION TO LAKE RUDOLPH.

ADVICES have been received from some members of the Villiers Expedition to Lake Rudolph. This expedition, it will be remembered, left England last October for the purpose of exploring the country around the Lake, going through southern Somali-land, and returning through the northern part of that "horn" of Africa. At the same time, comes a despatch from Sir Gerald Portal to the Earl of Rosebery, containing the astonishing information that "This afternoon we reached Sambaru, 35 miles from the coast, and here have been overtaken by Lieut. Villiers, *who informs me that he has been authorised to attach himself to this expedition as one of my staff,* defraying, however, his own expenses throughout." We should like to know *who* authorised Lieut. Villiers to leave those whom he had taken out from England under promise of leadership, and who will be responsible should harm come to any of his followers?

PHOSPHATES FROM INDIA.

SIR J. B. LAWES has recently received, through the India Office, a consignment of Phosphates from Madras, with a view of their commercial value being ascertained. The specimens, of which we have been favoured with samples, are well-formed nodules, with a nearly smooth buffish coat, and internally appear very pure. Unfortunately, they show no traces of fossils; but they come from Utatur, where there are both Cretaceous and Eocene Beds.

OUR MONTHLY SELECTION.

ONE does not expect accurate science in an ordinary newspaper, but yet it is not unreasonable to look for a general knowledge of the natural productions of our colonies in a paper supposed to be devoted to their interests. The following is taken from *The Colonies and India* of March 11, 1893, but we can assure would-be emigrants to New Zealand that they need not be afraid of meeting one of these birds, resembling an ostrich, but very much larger. Unfortunately for science, the Dinornis has been extinct for many years:—

"Dr. Reichenow read a paper at the last meeting of the Ornithological Society of Berlin, in which he gave some particulars of the finding of remarkable remains of gigantic birds in Argentina, double the height of the ostrich, which represent our living cassowaries and ostriches. In modern times many kinds of birds are becoming extremely rare, especially the dinornis races of New Zealand, which

are beginning to die out. Dr. Reichenow presented a specimen of one of these birds, a very rare and costly *Apteryx hasselti*, which inhabits the northern island of New Zealand, and while resembling an ostrich, is very much larger."

Dr. Nikitin has issued his seventh Record of the Geological Literature of Russia (for 1891). This record contains 452 items, the titles and a *précis* of the contents being given in Russian and French. Dr. Nikitin must be congratulated on the issue of this most useful work, and especially on the French translation, but for which, to the majority of foreigners, the rich geological literature of Russia would be unavailable. The most gratifying features, perhaps, in the book are the numerous and voluminous reports issued by the Governments on the nature of the soil and its agricultural value, and other matters of applied geology. This is the true aim and end of geology as far as the public is concerned, and we would like to see some works of this nature issue from our own Governmental office.

We are glad to observe, in the "Report of the Committee on the Present Condition of the Ordnance Survey," noticed under "Some New Books," that the Commissioners state (p. xxxii.) "that the absence of a path on the Ordnance Survey Map is no proof that there is not a right of way." This is a considerable improvement on the legend which appears on some of the recent one-inch maps, which reads thus: "The representation on this map of a road, track, or footpath is no evidence of the existence of a right of way," and we hope the legend will promptly be altered in all cases to the revised version.

Mr. John H. Cooke has an interesting paper in the February number of the *Mediterranean Naturalist* on "Some evidences of the occupation of the Maltese Islands by Prehistoric Man." He describes the evidences obtained by previous observers, and then relates his own results from the exploration of the Har Dalam Cave in 1892. Mr. Cooke found a stone implement and a human metacarpal associated with *Ursus arctos*, *Cervus*, *Elephas* and *Hippopotamus*, together with fragments of pottery of prephœnician page. The main results have been contributed to the Royal Society, and to the *Geological Magazine* (December, 1892), but the collating together of all the observations makes an interesting and useful article.

The leech *Hirudo brevis*, described by Grube from Chili in 1871, has been lately examined by Blanchard, who has given his opinion to the Academy of Sciences, Paris (*Compte Rendu*, 27th February, 1893), that it should form the type of a new genus, which he calls *Mesobdella*. After describing in detail the structure of the animal,

Blanchard goes on to say, by its peculiar characters, *Mesobdella brevis* (Grube) connects in a remarkable manner the Glossiphonidea with the Hirudinidea. Among the last, it approaches more nearly the Hemadipsinæ, as much by its mode of life as by the disposition of its eyes; but it is clearly distinguishable from them, as from all the other Hirudinidea by the great compression of the somites. The existence of this intermediate form shows that these two families are derived from a common stock, from which the Glossiphonidea have apparently deviated less than the Hirudinidea.

MM. Chevreux and De Guerne have some interesting observations on Crustacea and Cirrhipedes commensal on the turtles of the Mediterranean in the *Comptes Rendu* of the Academy of Sciences, Paris, 27 Feb., 1893. The observations were made during some excursions on the "Hirondelle," the "Actif," and the "Melita," in 1892. To a specimen of *Thalassochelys caretta* were attached *Lepas hilli*, some young *Conchoderma virgatum*, and a *Platylepas bissexlobata*, as well as the following crustacea: 16 *Hyale grimaldii*, 1 *Platophium chelonophilum*, 1 *Caprella acutifrons*, 4 *Tanais cavolinii*, and 3 *Nautilograpsus minutus*. On another specimen of the same Chelonian, which was abundantly garnished with the Alga, *Polysiphonia sertularioides*, no less than 259 Hyalæ, and several hundreds of Caprettæ, with other forms, were found.

Messrs. Warne & Co. announce the forthcoming issue of a new serial illustrated Natural History, edited by Mr. Lydekker The publishers have purchased electros of the greater number of the beautiful engravings in the third edition of Brehm's "Thierleben," and these, with the addition of coloured plates, ought to make the work highly acceptable to the public, altogether apart from the text. A large portion of the work will be written by the editor himself, but the assistance of specialists in certain groups has been secured.

Grevillea for March shows a steady improvement on its predecessors, especially in point of the illustrations. Mr. Batters makes a new genus, called Giffordia, in memory of the late Miss Gifford. It is made out of *Ectocarpus*. That old convenient genus is slowly breaking up, and in time will occupy a place like that of *Conferva*—the mother of genera. The reason, in the present case is the valid one of the discovery, by Dr. E. Bornet, of differences in important particulars between the male and the female cells, while typical *Ectocarpus* is isogamous. A great deal of work tending towards the unsettling of the present grouping of genera in Phacophyceæ has been recently done. There are the remarkable observations of Dr. Bornet on *Nemoderma Tingitana* (Algues de Schonsbœ in Mem. Soc. Nat. Sc. de Cherbourg, 1892), and those of Miss Mitchell and Miss Whitting on

Splachnidium rugosum (Phycological Memoirs, part i.), besides many minor observations of great value when taken into relation with others. Mr. Buffham, in his excellent "Algological Notes" in this current number of *Grevillea* describes plurilocular sporangia of *Chorda Filum* (of interest in the connection just alluded to) and a new species of *Giffordia*. A most valuable observation is that of the conjugation of zoogametes in *Cladophora lanosa*. Mr. Buffham deserves very hearty applause for these admirable notes—the more so since they are put forward very modestly in the shape of notes.

A TRANSLATION of Von Kennel's paper on "The Affinities and Origin of the Tardigrada," will be found in the March number of the *Annals Mag. Nat. Hist.* Kennel agrees with Plato in considering that the Tardigrada can be brought into relationship with the tracheata Arthropods, but he does not agree with him in considering that they lie nearest to the root of the Tracheate stem, or that they show most clearly the transition from the Annelids to the air-breathing Arthropoda. He goes on to point out the many resemblances to be found with the dipterous larvæ, and says that though it is by no means his attention to put forward the dipterous larvæ as actual ancestors of the Tardigrades, no single form so simply and so readily enables the student to interpret the Tardigrade body.

MR. FOX-STRANGWAY's Memoirs on "The Jurassic Rocks of Britain" (*Mem. Geol. Survey*), dealing with the Yorkshire areas, has just been issued, and we hope to give a notice of it as soon as the second part appears. In the meantime, it may be asked why the date 1892 is put upon the title-page? It is true that the preface is dated 28th April, 1892, but the tell-tale printer's date, December, 1892, occurs on the same sheet. Why this eight months' delay.

IN our January number, we referred to the visit of Sir H. Maxwell and Mr. Hasting to Thessaly, to investigate the value of Loeffler's method of destruction of field-voles by mouse-typhus. Sir H. Maxwell has an article on the subject in *Blackwood's Magazine* for March, in which he points out that the remedy is not effectual, on account of the difficulty of spreading the soaked bread, and, moreover, it is too costly to become general. Five francs' worth of the liquid suffices only for two acres, and to clear a farm of 6,000 acres would cost no less than £600 for typhus-broth alone, not counting bread and cost of labour.

IN his presidential address to the Geological Society of America (*Bulletin Geol. Soc. America*, vol. iv., pp. 179–190, February 27, 1893), Mr. G. K. Gilbert deals with a subject which has lately been discussed in NATURAL SCIENCE. He speaks of the permanence of

continents and ocean basins, and is strongly inclined towads the view that in the main they are permanent.

In the *Geographical Journal* for March, Dr. Hugh Robert Mill has a short paper on the Permanence of Ocean Basins.

In the *Journal of Botany* for March, Miss Barton makes progress with her "Provisional List of Marine Algæ of the Cape of Good Hope," and there is a paper by E. D. Marquand on the "Mosses of Guernsey."

There is a portrait and an interesting and full account of the career of Frederick Courteney Selous, the Nimrod of South Africa, in the March number of the *Review of Reviews*. The thirteen pages devoted to Mr. Selous bristle with adventures, and form altogether an instructive and readable record of the dangers and excitements of hunting big game. Mr. Selous is more than a hunter, for he has many times enriched the national collection with rare or new beasts; some of his most stirring experiences are illustrated in the article.

We learn from a telegram received from Berlin on the 15th inst. that Dr. Stuhlman, one of Emin Pasha's late companions, has arrived at that place. He has brought with him two female dwarfs from the Upper Ituri district of Central Africa, who will be examined scientifically by Professor Virchow. The telegram, however, does not contain any news of Emin.

Miss Agnes Crane informs us that the fifteen-spined sticklebacks (*Gasterosteus spinachia*) have just commenced their annual nest-building in the Brighton Aquarium.

Messrs. L. Reeve & Co. have in preparation a new work on the British Aculeate Hymenoptera from the pen of Mr. Edward Saunders, uniform with the same author's work on the Hemiptera Heteroptera just completed, and noticed in our last number.

On March 16, at a meeting of the Royal Society, Professor Rudolf Virchow delivered the Croonian Lecture, taking for his subject "The Position of Pathology among the Biological Sciences."

I.

The Mammals of Kilima-njaro.

GREAT interest attaches itself to Kilima-njaro, the mountain-mass in which equatorial Africa attains its highest development above the sea-level. At one time it was supposed, not unreasonably, that the investigation of its flora and fauna would materially assist in the solution of the problem of the former extension of northern forms of life into southern latitudes. Such has not proved to be the case, so far as our explorations have at present gone. But the study of the organic forms of Kilima-njaro, and of the high district that surrounds it, has, nevertheless, resulted in the discovery of many unexpected facts in distribution; and the recent publication of Mr. True's account of the mammals collected by a well-known American explorer—Dr. Abbott—in that region (1), invites us to offer a few remarks on that particular branch of its fauna.

The snows of Kilima-njaro were first observed, as is well known, by the German missionary, Rebmann, in 1848. Von der Decken, New, Fischer, and Joseph Thomson were the next four explorers who saw the mountain, and ascended its slopes to a greater or less extent; but, except some bundles of dried plants, and a few insects and bird-skins[1] (obtained by Dr. Fischer), little if any information as to its natural history was derived from these expeditions. In 1883 our ignorance of the fauna and flora of this specially interesting district was brought before the Royal Society and British Association by the writer, and a "Kilima-njaro Committee" was formed to endeavour to improve our knowledge of this subject. The result of the operations of this committee was the expedition of Mr. H. H. Johnston, in 1884. Mr. Johnston's instructions were to proceed direct to Kilima-njaro and pitch his camp there, high up, for six months, and to collect as much as possible in the vicinity of the snow-line. Unfortunately, Mr. Johnston, although he carried out the committee's directions as far as possible, was hampered by want of means. As he has explained to us in his most interesting and attractive narrative (2), being unaccompanied by European collectors, and failing to obtain the aid of native assistants, he was unable to accomplish all that could have been wished, in spite of his well-

[1] Among these were the first specimens of *Turacus hartlaubi*—a fine Touraco peculiar to Kilima-njaro.

known energy. But it is to Mr. Johnston that we owe our first acquaintance with the mammal fauna of Kilima-njaro, and, as will be seen by reference to Mr. Thomas's list, published in the "Proceedings" of the Zoological Society for 1885 (3), seventeen species of the mammals that inhabit this mountain thus first became known to us. The mammals obtained and observed by Mr. Johnston belonged mostly to well-known and widely-distributed species, such as usually fall into the hands of a first explorer; but Mr. Johnston made many good notes on the subject (4), and was the discoverer of the fine local form of the Guereza Monkey (*Colobus caudatus*), which is restricted to Kilima-njaro. Mr. Johnston remarks as follows on the monkey life of the district:—

"During eight months on the Congo, I only saw monkeys twice in a wild state, and that in one place only; and throughout my entire stay of sixteen months in West Africa, I can only remember six occasions on which I actually beheld these animals in a state of nature. On the other hand, I had scarcely left the East Coast to journey towards Kilima-njaro when monkeys showed themselves abundantly in the wilds.

"The first to attract my attention were the baboons, probably the species known as *Cynocephalus hamadryas*, *C. sphinx*, and *C. babouin*. They were generally found on the outskirts of native plantations, where they almost subsisted on the maize and other food-stuffs stolen from the gardens of their more highly-developed fellow primates. In the inhabited region of Kilima-njaro, generally known as the country of Caga, baboons were strangely abundant. They were generally in flocks of fourteen to twenty, of all ages, and both sexes. They were so little molested by the natives that they showed small fear of man, and, instead of running away, would often stop to look at me about twenty yards off, and the old males would show their teeth and grunt. I have frequently seen the natives driving them from the plantations, as they might a troop of naughty boys, and the baboons retreating with swollen cheek-pouches, often dragging after them a portion of the spoil. On one occasion, in a river-bed at the foot of Kilima-njaro my Indian servant, ordinarily a very plucky boy, met a troop of baboons, who, instead of fleeing up into the trees, came running towards him in a very menacing manner, and he was so frightened at their aspect that he took to his heels. The baboons followed, and, but that the boy forded the shallow stream, and put the water between him and his pursuers, he might have had an awkward contest. I killed a baboon once in Caga, one of a troop who were rifling a maize plantation, and its companions, instead of running away, surrounded the corpse and snarled at me. As I had fired off both barrels of my gun, and had no more ammunition, I went back to the settlement to fetch some of my followers, and upon the approach of several men the baboons ran off. We picked up the dead one and carried it back. It was a female, and apparently young and tender. Out of curiosity, I had its flesh cooked the next day and ate it, hoping in this lawful way to form some idea of the practice of cannibalism; I can only say that the succulence and quality of this creature's flesh were quite unexceptionable. I have noticed this with most of the species of Old World monkey I have as yet tasted. During my four months' stay in Mandara's country I ate the common *Cercopithecus* constantly, and found it made a very tooth-

some stew. The most remarkable monkey in all this region is probably the *Colobus*, which apparently offers a new variety or sub-species in the country round Kilima-njaro. remarkable for having an entirely white, heavily-plumed tail. The common species, with a black tail tipped with white, I have shot in the forested plains near the coast. The Colobus monkey is almost the only one that quite avoids the neighbourhood of man; the other genera frequent the vicinity of native plantations, and doubtless profit by the abundance of cultivated food.

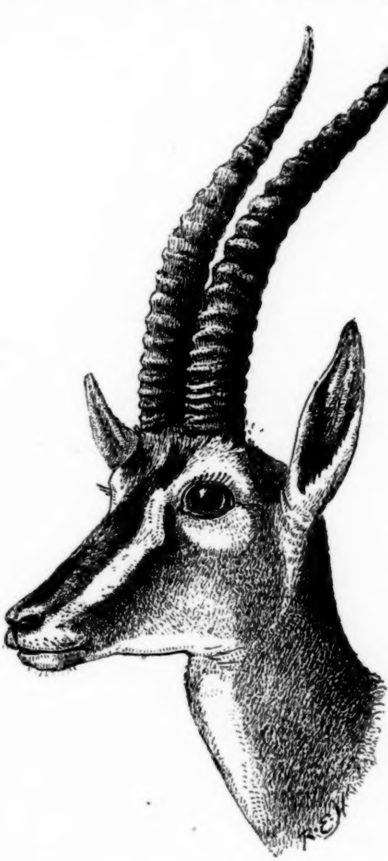

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Fig. 1.—GRANT'S GAZELLE *(Gazella granti).*

I never observed any *Galago* (a lemuroid animal) in this district, nor do the natives speak of one, although it is a genus well represented in other parts of Africa."

The sporting trip of Sir Robert Harvey and his friends to Eastern Africa, in 1887, and the consequent publication of Sir John Willoughby's "East Africa, and its Big Game" (5), resulted in another important contribution to our knowledge of the

mammals of the Kilima-njaro district, though no attempt was made to form a scientific collection. In the vicinity of what is well termed the "hunter's paradise" of Taveta, situated at an elevation of about 2,400 feet on the south-eastern slope of the great mountain, antelopes and other large "game-animals" were abundant. Speaking of one of his excursions from their headquarters, Sir John Willoughby says: "The grassy plain through which we marched was simply crawling with hundreds of *Gazella granti*, Wildbeest, Hartebeest, and Zebra." At that time, "any amount of game" was to be seen there, although these days are, we fear, already past and gone for ever. During their four months' stay in this earthly paradise, some 350 head of large "game" were obtained, amongst which were no less than 66 Rhinoceroses. The most abundant Antelopes in the district appear to have been the Coke's Hartebeest (*Bubalis cokei*), the Grant's Gazelle (*Gazella granti*), the Mpallah (*Æpyceros melampus*), and the Waterbuck (*Cobus ellipsiprymnus*).

The Hartebeest was "quite the most common Antelope on the plains, being found everywhere in immense herds." Grant's Gazelle, perhaps the finest species of this beautiful group, was also "common everywhere on the open plains," one male being accompanied by as many as from ten to fifteen females. The Mpallah is stated to be abundant in the bush as well as on the plains, and the Waterbuck to be "found everywhere near the rivers and marshes." Of other Antelopes met with by these fortunate sportsmen, we find the Eland (*Taurotragus oreas*) mentioned as "rather local." Both males and females in this district are more or less striped. The large Kudu (*Strepsiceros kudu*) was only seen on two or three occasions, and the Lesser Kudu (*S. imberbis*), though found in the bush near Taveta, is not common.

A very charming species, of which Sir Robert Harvey and his party were, I believe, the first to obtain perfect specimens, is Thomson's Gazelle, discovered by Mr. Joseph Thomson during his journey through Masailand in 1883, and discriminated by Dr. Günther from a pair of horns. This handsome little Gazelle was "found in large numbers in the plains to the south-west of the mountain, and occasionally mixed with herds of *Gazella granti*. Another graceful Antelope, "plentiful on the plains, and in thin thorny bush near Taveta," was the Oryx of the district. In his notes on the animals met with, Mr. Hunter refers to this Oryx as the Beisa (*Oryx beisa*); but, as has been recently shown by Mr. Thomas (6), the Oryx of Kilima-njaro is not the true Beisa, but an allied species, distinguished by its pencilled ears and different markings. Altogether, examples of sixteen species of Antelopes were obtained by Sir John Willoughby and his friends in the vicinity of Taveta, besides one or two others observed or heard of. At that epoch also the Giraffe and Zebra were very common in the plains near Taveta, and the Elephant was found in the forest of Kilima-njaro. Mr. Hunter's Appendix to "East Africa

Fig. 2.—Thomson's Gazelle (*Gazella thomsoni*).

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and its Big Game" also contains notes upon other mammals obtained and observed during this remarkable excursion.

A few months after Sir Robert Harvey and his friends had quitted their post at the foot of Kilima-njaro, a learned German geographer, Dr. Hans Meyer, accompanied by Herr von Eberstein, was engaged on an energetic attempt to climb the untrodden summit. On this occasion only the ice-cap was reached, at an elevation of about 18,000 feet, as it was found impossible to ascend further "without the aid of the usual Alpine climbing tackle." The results of this expedition were published in the work entitled "Zum Schneedom Kilimandscharo" (7), and illustrated by splendid photographs, which no one who wishes to form an idea of this remarkable mountain and its surroundings should omit to consult.

Nothing daunted by his comparative failure on the first occasion, Dr. Hans Meyer returned to the charge next year. In his second expedition he took as his companion a well-known Austrian geographer, Dr. Oscar Baumann, who had had a large experience of African travel on the western coast. Landing at Zanzibar in July, 1888, the travellers indulged in a preparatory excursion into Usambara—a high district opposite the island of Pemba, which forms the north-east corner of German East Africa; there, unfortunately, they fell into the hands of the revolted Arabs, and, after serious maltreatment, barely escaped with their lives back to Zanzibar and Europe.[2] Dr. Meyer's pluck and energy were, however, by no means exhausted by this sad event, and a third expedition was immediately planned and carried out. This time, Dr. Meyer determined to take with him an experienced Alpine climber, and was fortunate in securing the companionship of Herr Ludwig Purtscheller—a name well-known in Alpine circles. The event on this occasion fully rewarded Dr. Meyer for the trouble he had taken. All that had been left undone on the two first expeditions was fully accomplished on the third. The great crater of Kibo was discovered, the summit of the mountain at an elevation of 19,720 feet was attained, and named (of course) "Kaiser Wilhelm Peak," and an accurate survey of the whole district was carried out, besides which scientific collections in several branches of Natural History were formed. The results of this successful expedition were given to the world in 1891 in the splendid monograph entitled "Across East African Glaciers" (8), of the merits of which it is almost impossible to speak too highly.

Dr. Meyer does not seem to have paid much attention to the mammals of Kilima-njaro, although he made special collections of its butterflies and plants. He mentions, however, the occurrence of "The Eland" on the mountain at the extraordinary height of 15,000 feet. As, however, this animal was only recognised by its "footprints and droppings" in the boggy ground, I should rather imagine it might

[2] See Dr. Baumann's account of this perilous journey in his charming book "In Deutsch-Ostafrica wahrend der Aufstandes." Vienna: 1889.

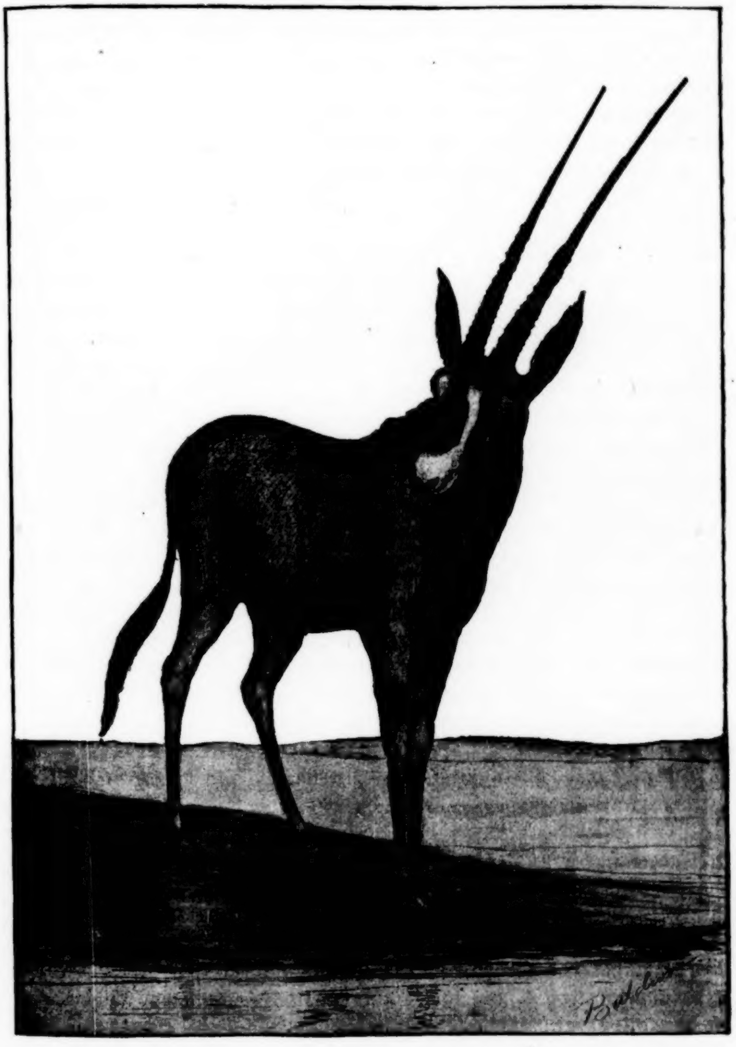

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Fig. 3.—PENCIL-EARED ORYX *(Oryx callotis)*.

have been the Koodoo, which Mr. Johnston also met with on Kilima-njaro (*op. cit.*, p. 354), and which Mr. Hunter believes that he recognised (at 9,000 feet) by "the crumbling core of an old horn."

Another passage in Dr. Meyer's work is of still greater interest as regards the mammals of Kilima-njaro. When climbing the ice-sheet of the Kibo crater from the west, at a height of 20,000 feet the travellers found the dead body of an antelope—one of the small species they had noticed on the pasture-lands below. This was, in all probability, *Cephalophus spadix*, discovered by Dr. Abbott, to whose labour we must now proceed to refer.

The American naturalist and explorer, Dr. W. L. Abbott, spent nearly eighteen months on Kilima-njaro and its vicinity in 1888 and 1889, and collected a splendid series of its mammals, which was presented to the U.S. National Museum at Washington. The specimens have been very carefully worked out by Mr. Frederic W. True, Curator of the Department of Mammals of that institution, and we must now devote our attention to his excellent memoir on this subject (1) lately published.

Mr. True tells us that Dr. Abbott's specimens are "prepared with much care, the skins being almost invariably accompanied by the skulls, and furnished with labels giving the locality and date of capture, sex, and other particulars." Adding to Dr. Abbott's series the names of the species recognised by former observers, Mr. True finds that the mammalian fauna of Kilima-njaro and the surrounding district includes about seventy species.

The Quadrumana of Kilima-njaro, according to Mr. True's list, are of four species—three *Cercopitheci* (this being one of the most abundant and most characteristic groups of Æthiopian Monkeys), and one *Colobus*—namely, *C. caudatus*—the localised form of *C. guereza* already alluded to. To these will have to be added a Baboon (*Cynocephalus*), of which Mr. Johnston saw numerous examples, and concerning which, I think, he can hardly have been mistaken, although we do not yet know the exact species.

Of the Lemurs, the only species yet recognised from the mountain is *Galago crassi-caudatus*, which Dr. Abbott found "common" in the forests of Taveta; but the natives state that there are three other kinds of these animals in the same district. One of them may be *Galago garnetti*, which the Zoological Society has received living from the Zanzibar coast.

The Carnivora are more numerous in Kilima-njaro. The Lion, Leopard, Serval, and Cheetah are all attributed to this district by Sir John Willoughby and his brother sportsmen, and, no doubt, correctly. The Leopard is stated to be common on the mountain up to six or seven thousand feet in altitude, and to be very arboreal in its habits. The Viverridæ are also well represented. Dr. Abbott obtained examples of seven species, among which is the Ratel (*Mellivora capensis*), said to be "rare upon the mountains," and a Genet

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Fig. 4.—Abbott's Antelope (*Cephalophus spadix*).

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(referred by Mr. True to *Genetta pardina*) which varies excessively in colouration. Mr. Hunter included both the Striped and Spotted Hyenas as met with on the plains surrounding the mountain, the former being "very common everywhere." The Canidæ of Kilima-njaro are not yet accurately made out. Mr. True refers Dr. Abbott's specimens of Jackals to *Canis mesomelas* of the Cape; Mr. Johnston and Mr. Hunter associate this animal with *Canis lateralis* of the West Coast. Mr. Hunter also speaks of a "Wild Dog" that "hunts in packs" on the plains, and of another "small, dark-coloured fox." The latter, however, may be *Otocyon megalotis*, of which Dr. Abbott obtained three specimens.

Two species of *Hyrax* are met with on Kilima-njaro, one belonging to the tree-loving and the other to the rock-frequenting section of this isolated group. Mr. True refers the former to a new species, *Dendrohyrax validus*, and the latter to *Procavia brucei* (Gray). He has not had the advantage of consulting Mr. Thomas's recently-published revision (9) of this very difficult family, so that the latter determination may be doubtful.

Of Rodents, Mr. True registers fourteen species in his list, and the number will, no doubt, be seriously increased when fresh explorers in Kilima-njaro turn their attention to these little animals. Among the Muridæ, a new species of *Dendromys* "extends the range of this genus from South Africa to East Africa."

The list of Kilima-njaran Bats is also very short up to the present time. Mr. True only mentions four species. It cannot be doubted that these creatures are much more numerous, but they are difficult to capture, and do not excite the enthusiasm of the ordinary collector. The Insectivora are not abundant anywhere. In Kilima-njaro only two species have been yet recognised. These are a Hedgehog (*Erinaceus albiventris*), and a Shrew (*Crocidura*).

We now come to the most highly-developed and interesting portion of the mammal-fauna—that is the Antelopes, abundant all over Africa in suitable localities, and especially so on the high plateau near Kilima-njaro. Mr. True includes the names of twenty-one species in his list, of thirteen of which examples were obtained by Mr. Abbott, while eight others had been recorded by Mr. Hunter, as already mentioned. The list must, however, be slightly reduced, as Hunter's Antelope (*Bubalis hunteri*) is only met with in Southern Somali-land on the north bank of the Tana, a long way from Kilima-njaro, and should be omitted altogether. Again, as Mr. True allows it is not at all likely that two allied species of *Madoqua* occur there, Mr. True's *Neotragus kirki* and *N. damarensis* are probably identical. Moreover, as shown by Dr. Günther (*P.Z.S.*, 1890, p. 604, x.), the Reed-buck of this part of East Africa is *Cervicapra bohor*, not *C. arundinum*, and the so-called *Cephalophus nigrifrons* is, no doubt, Mr. Thomas's recently described *C. harveyi* (xi.). This would make the Antelopes of Kilima-njaria at present known

about nineteen in number — namely, according to my nomenclature: —

1. *Bubalis cokei.*
2. *Connochætes taurinus.*
3. *Cephalophus grimmi.*
4. ——— *harveyi.*
5. ——— *spadix.*
6. *Madoqua kirki.*
7. *Neotragus moschatus.*
8. ——— *tragulus.*
9. *Cobus ellipsiprymnus.*
10. *Cervicapra bohor.*
11. *Æpyceros melampus.*
12. *Gazella granti.*
13. ——— *thomsoni.*
14. *Lithocranius walleri.*
15. *Oryx callotis.*
16. *Tragelaphus roualeyni.*
17. *Strepsiceros excelsus.*
18. ———*imberbis.*
19. *Taurotragus oreas.*

It should be noted that the Brindled Gnu of Uganda and of this district seems to differ from the typical form of South Africa in having the throat-mane and jaw-tufts whitish or white, and has been made a sub-species by Mr. Thomas, as *Connochætes taurinus albojubatus* (xii.). There seems, however, to be no interruption in the range of this animal, which occurs, wherever the country is suitable, from the north of the Vaal up to Uganda. North of the Zambesi it has been recorded in Mozambique by Peters, in Nyassaland by Crawshay, and on the Kirgani River, opposite Zanzibar, by Speke. Mr. Hunter tells us it is found on the high plains N.E. of Kilima-njaro, but, unfortunately, calls it *Connochætes gnu.*

Besides the Antelopes, one of the forms of *Bos caffer* is abundant on the plains of Kilima-njaro, and, according to Dr. Abbott, as quoted by Mr. Hunter, ascends the mountain to an altitude of 10,000 feet. This completes the list of Bovidæ. The Giraffe was also (a short time ago) "very common round Taveta." Passing on to the Suidæ, both the Riverhog (*Potamochærus*) and Warthog (*Phacochærus*) are abundant in Kilima-njaria, and the Hippopotamus is found in Lake Jipe, and in "every large swamp." The Perissodactyle division of the Ungulates is represented by the Rhinoceros (*R. bicornis*) and one of the Zebras. I have always supposed this Zebra to be the northern form of Burchell's Zebra, with the legs striped outside (*Equus burchelli chapmanni*), but Herr Matschie has recently made a new name for it, *Equus boehmi*,[3] and he may possibly be justified in doing so. At the same time, there is great individual variation in the markings of Zebras, and it is very hazardous to base species on single skins and on sportsman's sketches.

The long list of Kilima-njaro Mammals is closed by the Elephant, which "lives in the thick damp forest, from 6,000 to 9,000 feet," in the dry season, descending to lower altitudes during the rains.

After this sketch of the Mammalian Life of Kilima-njaro, it will be evident that, so far as this part of its fauna is concerned, there are no traces of northern forms in Equatorial Africa, even at this excessive elevation above the sea-level. We might well have expected a Wild Goat to occur on the summit of Kilima-njaro, as it does on the mountains of Abyssinia.[4] Instead of a *Capra*, however, we find a

[3] *Sitz. Ges. nat. fr. Berlin*, 1892, p. 133.

[4] *Capra walie*, Rüppell.

species of *Cephalophus*, a characteristic Æthiopian genus of Bovidæ. Nor, so far as we know at present, are there any traces of Marmots, Pikas, or Mountain-hares on Kilima-njaro. The places of these Boreal forms are taken by *Hyrax* and various species of Muridæ. In short, we find on Kilima-njaro merely more or less modified representatives of the inhabitants of the surrounding districts. So far as this piece of evidence goes, the wave of Boreal life, impelled by the Glacial Period, did not in Africa advance so far south as the Equator. What we *do* find in Kilima-njaria, however, is the most splendid series of the larger mammals to be met with in any spot on the earth's surface, such as may well justify Sir John Willoughby and his friends in terming their headquarters at Taveta the "Hunter's Paradise."

[Three of the illustrations prepared for this memoir have been kindly lent by the authorities of the U.S. Nat. Museum for the present article.]

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P. L. SCLATER.

II.

Christian Konrad Sprengel.

FEW men have been more in advance of the age in which they lived, or have suffered so long an undeserved oblivion, as the subject of this brief sketch. No mention of him is made in the Biographical Dictionaries, nor in the histories of Botany prior to that of Sachs (1875). Had not his discoveries been re-enunciated and extended by Charles Darwin, his name might even now be wanting in the roll of famous botanists. Very little is known about his earlier life. Born in 1750, he became Rector of Spandau, near Berlin. There, under Heim, he began the study of Botany, and became so enthusiastic over it that he neglected his duties as Rector, and was ejected from his post. He migrated to Berlin, where he supported himself by giving lessons in languages and in botany, and took up a lodging on the Hausvoigtei-Platz in a back room at the top of the house. "Here," says one of his old pupils (from 1809 to 1813) in an enthusiastic account of him in "Flora" of 1819, "I always found him, in an old bedgown, with a nightcap and a long pipe, the room filled with clouds of tobacco smoke. He sat generally at the window, with a book or his herbarium. Shelves of books, his collection of plants, and a few old household goods completed the contents of the room."

He goes on: "In figure Sprengel was well-built, rather large than small, lean, and raw-boned. His face was full of expression, the colour fresh, the glance vivacious. He wore his hair, which was prematurely grey, uncut, hanging about his shoulders. His gait was firm and upright; he walked fast, and, in spite of his age, went for half-a-day without rest. He was simple and frugal . . drank only water . . was never married."

Sprengel's only contribution to botanical literature is his now famous work, "Das Entdeckte Geheimniss," which was published in 1793, just one hundred years ago. This book—of which more hereafter—was too far in advance of its time, and met with a chill reception, which did not encourage its author. Besides being despised as a visionary by the dry systematists of the Linnæan school who then held sway in botany, Sprengel seems to have been too fond of speaking the truth, regardless of consequences, and thus became very unpopular,

and more and more forced into the seclusion in which we have already seen him. He was beloved, however, by his pupils.

On Sundays he usually conducted botanical excursions to the country round Berlin; any one might join these trips on payment of two or three groschen. On these occasions Sprengel was not merely a botanist, but would give instruction in anything that turned up. "He explained equally well the inscription on a tombstone, the construction of a windmill, the course of the stars, or the structure of a plant. . . . Knowing the country well, he led us always to places where rare or remarkable plants were to be found. There were few places where he had not himself found something new, or noticed something special, and he gladly took the opportunity of leading us thither. Thus he showed us at one place the divided sexes of *Mentha aquatica*,[1] which he had noticed there first, and afterwards observed in other species of Mentha. . . . In the Zoological Garden the Scrophularia gave him opportunity to explain dichogamy (see below). He was firmly convinced of the fertilisation of most flowers by insects, and he could, on this theory, so clearly explain the structure of flowers that it was a pleasure to watch and to listen to him. . . . The commonest plant became new by what he had to say about it; a hair, a spot, gave him opportunity for questions, ideas, investigations. Much remained a mystery to him; he was most exercised over the structure of *Parnassia*. Here he was unable to catch nature in the act."

Towards the end of his life he abandoned botany and devoted himself entirely to languages; he took up English, and was full of its great advantages. "He often said that Linnæus did not understand Greek, and had brought many errors into the nomenclature. He also blamed Willdenow for introducing the long and incorrect name *Pelargonium*, which should have been *Pelargium*." He died in Berlin in 1816 at the age of 66.

The chief interest of Sprengel's life centres in his famous book "Das Entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen" (The Secret of Nature discovered, in the structure and the fertilisation of flowers). This was published in 1793 as a quarto volume of 222 pages, with 25 large copper plates, the latter being wonderfully accurate and well executed. In this volume Sprengel gives details of his observations on most of the wild flowers round Berlin, and many cultivated ones, all leading to the general conclusion that flowers are, mostly, adapted for fertilisation by insects. He shows how the insects are attracted, rewarded for coming by the honey, &c., and how almost every minutest structure in the flower, down to hairs and spots on the corolla, can be explained

[1] This plant is gynodiœcious, *i.e.*, bears upon some plants large hermaphrodite flowers, and on other plants smaller female flowers with aborted stamens. The same phenomenon is seen in many other plants of the order Labiatæ.

with reference to insects. The best way, perhaps, of treating the subject will be to let Sprengel speak for himself. His book begins as follows :—

"In the summer of 1787 I was carefully studying the flower of the wood crane's bill (*Geranium sylvaticum*) and I found that the lowest part of its petals was provided, on the inner side and the edges, with fine soft hairs. Convinced that the wise Author of Nature had not created a single hair without a definite end, I reflected as to what purpose these hairs might serve, and it soon struck me that if one supposed that the five honey drops, which are secreted by the same number of glands, were designed for the nutriment of certain insects, one would find it, at the same time, not improbable that care should be taken to keep the honey from being spoiled by rain, and that to attain this end these hairs were created. Every honey-drop sits on its gland immediately under the hairs, which occur on the edges of the neighbouring petals. Since the flower stands upright, and is pretty large, raindrops must fall into it during showers. None of the drops, however, can reach and mix with a honey-drop, being prevented by the hairs, just as drops of sweat are prevented from running down into the eye by the eyebrows and eyelashes. An insect, on the other hand, will not be in any way hindered from reaching the honey. After this I investigated other flowers, and found that several of them had something in their structure which seemed to serve the same end. The longer I pursued this research, the more I perceived that those flowers which contain honey are so arranged that, whilst insects can easily reach it, it cannot be injured by rain. I concluded, therefore, that the honey of these flowers, at least primarily, is secreted for the benefit of insects, and, that they may obtain it pure and uninjured, is protected from rain.

"In the following summer I investigated the forget-me-not (*Myosotis palustris*), and I found that not only does this flower contain honey, but that the honey is fully protected from rain. At the same time, however, I was struck by the yellow ring which surrounds the mouth of the corolla tube, and contrasts so beautifully with the azure blue of the limb. Is this circumstance also, thought I, to be referred to insects? Has Nature coloured this ring for the express purpose of showing insects the way to the honey receptacle? I examined, with regard to this hypothesis, other flowers, and found that the majority supported it. For I saw that those flowers whose corolla, as commonly happens, is coloured differently in one place than in the rest, always have these spots, figures, lines, or dots of special colour at the place where the entrance to the honey is found. Now I reasoned from the part to the whole. If, I thought, the corolla is coloured in special places on account of insects, its general colour must also be on their account; and if the special local colouring serves to direct to the honey an insect which has already alighted upon the flower, the general colour of the corolla must serve to attract

from afar, by showing the presence of honey, the insects that are swarming about in the air in search of food.

"Examining, in the summer of 1789, some species of *Iris*, I soon found that Linnæus had erred in regard both to the stigma and the nectary; that the honey is fully protected from rain; and, finally, that there is a specially coloured place, leading insects to the honey. But I found more than this, namely, that these flowers cannot be fertilised at all except by insects, and then only by insects of fairly large size. Although I did not, at the time, find this idea confirmed by experience (this occurred in the following summer, when I actually saw humble-bees creeping into the flower), still I was convinced of its truth by the general appearance. I endeavoured, therefore, to discover whether other flowers are also so constructed that they can only be fertilised by insect agency. My investigations convinced me more and more that many—perhaps all—flowers which contain honey are fertilised by insects which feed upon the honey, and that, consequently, this nourishment of the insects is, in regard to them, the final end, but, in regard to the flowers, is only a means, and, indeed, the sole means, to a definite end, viz., their fertilisation, and that the entire structure of such flowers can be explained, if, in their investigation, one keep always in view the following principles:—

"1. These flowers are fertilised by this or that species of insect, or by several.

"2. This also will occur, that the insects, as they visit the flowers for honey, and in consequence of this, either rest upon the flowers in some indefinite way, or in a definite manner either creep into the flowers or run round upon them, will, of necessity, be smeared with pollen from the anthers, either over the greater part of their hairy bodies, or only over a part of them, and will rub this pollen upon the stigma, which, for this end, is either covered with short and fine hairs, or with a damp, often sticky, secretion.

"In the spring of 1790 I perceived that *Orchis latifolia* and *O. Morio* have, in all respects, the structure of a honey flower, but do not contain honey. I thought at first that this observation, if it did not actually overthrow my former discoveries, would at least make them very doubtful. For, since these flowers have a honey guide (so have I termed the differently coloured spot on the corolla)—and yet this cannot show insects the road to the honey, as there is none[2]—it appeared to follow that the honey guides also, on those flowers which do contain honey, were not really for this purpose at all, and that the whole thing was a mere fancy. I must, therefore, confess that this discovery was in no way pleasant to me. But just this spurred me on to study these flowers more attentively, and to observe them in the field, and at last I discovered that these flowers are fertilised by

[2] Darwin showed that insects visiting Orchis drill holes into the tissue of the spur and suck the juice therein contained, so that the flower is not really an exception to Sprengel's views.

certain flies which, deceived by the appearance, imagine the spur to contain honey, and creeping in, tear the pollen masses from their chambers and bring them upon the sticky stigma. Flowers of this type, which have fully the appearance of honey flowers, but do not contain honey, I call 'sham honey-flowers' (Scheinsaftblumen). That there are more of them, I saw in the same year on the common birthwort (*Aristolochia Clematitis*). I found, namely, that this flower also, which contains no honey, is formed in every way like a honey flower, and, on this account, small flies of all kinds creep into it. In the following summer I saw clearly that this flower is a true wonder of nature, namely, that these flies are led by the appearance of the flower to creep into it, that they may fertilise it, and that they are held prisoners in it until they have done so, but that as soon as this has occurred they are released from detention.

"In the summer of the year above mentioned I discovered, in *Epilobium angustifolium*, something upon which I had never happened before, namely, that this hermaphrodite flower is fertilised by humble and hive bees, not, however, each flower by its own pollen, but the older flowers by means of pollen carried by insects from the younger.[3] This observation shed great light upon many of my earlier discoveries. I was especially pleased when I found a similar method of fertilisation in the wild love-in-a-mist (*Nigella arvensis*). In the summer of 1788 I had perceived the beautiful arrangements of the nectaries of this flower. In the following summer observation showed me that it was fertilised by bees. At the time I thought I fully understood how this came about. Now, however, I found that I had erred in regard to the last point, because then I still believed all hermaphrodite flowers to be fertilised by their own pollen.

"Finally, last summer I studied the common spurge (*Euphorbia Cyparissias*) and found in it an arrangement the exact opposite of that described above, the flower being fertilised by insects, but in such a way that they carry the pollen of older flowers to the stigmas of younger ones.

"Upon these six chief discoveries, made in five years, is founded my 'Theory of Flowers.'"

After a discussion of the subject of nectar and its uses, in which he demolishes the older views, such as that the nectar causes the growth of the ovule to a seed by keeping it damp, or that it is an injurious substance, whose removal by insects is therefore a direct benefit to the plant, Sprengel goes on to point out how in all honey flowers the following five points may be observed, viz.:—(1) The honey gland or *nectary*; (2) the *honey receptacle*, in which is stored the honey secreted by the gland; (3) some arrangement to protect the

[3] The flower is *dichogamous*, *i.e.*, the stamens and pistil do not ripen simultaneously. In young flowers the stamens are ripe, the style folded back out of the way; in older ones the style occupies, with its ripe stigmas, the place formerly held by the now empty and withered stamens. This phenomenon is termed protandrous dichogamy or protandry; the reverse case (*Euphorbia*) protogyny.

honey from the rain; (4) arrangements to enable insects easily to find the honey, such as size and colour of the corolla, scent, and the honey-guides or "path-finders" formed by the differently-coloured spots near the entrance to the honey; (5) the general impossibility of spontaneous self-fertilisation, owing largely to dichogamy or other arrangements, and the necessity of insect aid.

The book contains an enormous mass of the most painstaking observations on numerous flowers, undertaken with these ideas in view. There is, however, one very serious blemish in it, which, perhaps, as much as anything, caused its rejection by botanists. Sprengel was most careful to find reasons for everything in the structure of the flower, and yet he did not try to give a reason for flowers being adapted to fertilisation by insects. Why should a flower go to the trouble and expense of attracting insects merely to effect fertilisation, which it might do for itself very easily? Sprengel observed that by dichogamy and other arrangements it constantly occurred that a flower was fertilised, not with its own pollen, but with pollen from a different flower. He even went so far as to say, "Since very many flowers are unisexual, and apparently at least as many of the hermaphrodites are dichogamous, Nature seems to have intended that no flower should be fertilised by its own pollen," and yet he did not suspect that this was the whole point of the fertilisation by insect agency. Darwin and others have shown the great benefits arising from cross fertilisation, and have thus explained why plants should have become adapted to fertilisation by insects in the various ways described by Sprengel. Had Sprengel been aware of this point, and incorporated it in his theory of flowers, it seems unlikely that his work could have fallen into the oblivion which soon overtook it. Even so late as 1850, the work could be bought for 1s. 6d. (it is now quoted by Friedländer at 22s.). In 1841 it came into the hands of Charles Darwin. "The book impressed him as being 'full of truth,' although with 'some little nonsense.' It not only encouraged him in kindred speculation, but guided him in his work, for in 1844 he speaks of verifying Sprengel's observations" (Life, by Francis Darwin). He rehabilitated Sprengel by his biological work, especially the "Origin of Species," the "Cross and Self-Fertilisation of Plants," where he recounted the results of a long series of experiments showing the benefits of cross fertilisation, and, lastly, by his brilliant work on "Fertilisation of Orchids," a book of observations on flowers, conducted much on Sprengel's lines, but with the flaws of his theory removed. Since this time, the whole subject of fertilisation, by insects and otherwise, has received much attention at the hands especially of Hildebrand, Axell, Delpino, Hermann and Fritz Müller, and recently Macleod and Robertson. To the writings of these authors, reference must be made for further information, and we must here take our leave also of Sprengel, a man deserving of a high place in the History of Botany, but most unjustly forgotten for nearly seventy years after the publication of his classic book.

JOHN C. WILLIS.

III.

The Recapitulation Theory in Palæontology.

NATURAL SCIENCE is to be congratulated on the publication of an article so opposed to current belief as that of Mr. C. Herbert Hurst on "The Recapitulation Theory," for it has thereby shown that it will not burke views simply because they are unfashionable, but rather that it is ready to afford a free field to all genuine knights-errant who dare to smite the shield of authority. Whether the heterodox opinions prove ultimately right or wrong, their publication is of service as forcing us to consider more carefully than we are apt to do the reasons for the faith that is in us. No doubt there will be many to answer Mr. Hurst's challenge, some, perhaps, to support him; out of the *mêlée*, truth is most likely to arise if each confines himself to facts within his own knowledge; here are a few such.

The heaviest blows of Mr. Hurst fall on the embryologists, or, to speak more accurately, on those who study the embryology of living beings, "without the labour involved in palæontological research." Such an attack is undoubtedly deserved in many cases; but Mr. Hurst himself would have strengthened his position had he been able to bring forward any arguments from the actual history of extinct beings that should upset the conclusions of the neontologists, or that should definitely disprove the dictum—"Ontogeny repeats Phylogeny." This he has not done, and this I do not intend to do for him. In the first place, though it would be easy to show that the genealogies constructed by neontologists were contradictory both of one another and of the facts of palæontology,[1] this would merely prove that somebody had made mistakes, an argument admirably adapted for the daily Press, but not for a scientific journal. In the second place, the very limited amount of accurate palæontological knowledge that I possess does not enable me to produce any facts opposed to the theory of Recapitulation as understood by most modern biologists.

First, let us consider the case of *Antedon*, which Mr. Hurst dismisses so scornfully. The possession of a stem is, we may admit, an advantage to the larva, and Mr. Hurst's contention that the larval

[1] See a recent article by A. Smith Woodward on "The Forerunners of the Backboned Animals," NATURAL SCIENCE, vol. i., p. 596.

stem of *Antedon* is the equivalent of the *larval* stem of *Antedon's* ancestors, would be at least a possible explanation, were it not for one fact: the stem-ossicles of the *Antedon* larva are not at all of a simple type, they have a very peculiar specialised structure, and, broadly speaking, resemble the stem-ossicles of the Bourgueticrinidæ so common in the Upper Chalk. It is a mistake to call this larva "pentacrinoid"; if any genus is known to us with which it may be compared, that genus is *Thiolliericrinus*, of the Jurassic rocks, many species of which show a gradual loss of the stem and development of cirri around the base of the cup. What the ancestors of *Thiollieri-crinus* may have been we cannot say with certainty; this only seems clear, that the structure of the stem is specialised. A somewhat similar structure was developed in the Carboniferous Platycrinidæ, from which, however, it is not likely that *Thiollericrinus* was derived. Such stems do not occur lower than the Carboniferous, and we must infer that the ancestors of both Platycrinidæ and Bourgueticrinidæ had stems of the primitive Palæozoic type, with round ossicles radiately ridged. From such ossicles all other types may easily have been derived. Now, to accord with Mr. Hurst's explanation of the *Antedon* stem, it must be supposed, either that the larval stem of all crinoids has always been of this specialised type, which is contrary to all available evidence, or that its structure is a special larval development. Surely it is hardly probable that an organ which is only in use for a few days of the creature's life should have become specialised in just the same way as the stem of the adult ancestors. It is certainly easier for the ordinary mind to imagine that, by acceleration of development (a principle ignored by Mr. Hurst), the structure of the adult ancestor has been pushed back to the larval stages of the existing *Antedon*.

But the stem is by no means the only structure in the larval *Antedon* that bears on the Recapitulation Theory. "Each transient stage in the development of an individual," says Mr. Hurst, "is a modification of the corresponding stage of development of its ancestors." Let us see how this is borne out by the development of the cup-plates.

The most important peculiarity of the larva as distinguished from the adult *Antedon* is the presence of a plate in the anal interradius. At an early period this plate appears between two of the radials, and on the same level with them; subsequently it is lifted out from between the radials, which close in under it as it passes upwards, so that at last the radial circlet is quite continuous, and the anal plate lies above it. At about this stage the crown is separated from the stem; shortly afterwards, the orals disappear, and a little later, the anal plate is itself absorbed and vanishes. Now, on Mr. Hurst's theory, each of these stages should be represented in the early development of the ancestors of *Antedon*; but this would raise far greater difficulties, for the oldest crinoids do not possess this anal plate at all, at all

events not in the position that it first occupies in *Antedon*. It appears from palæontological evidence that this plate first appeared above the level of the radials, that it gradually sank down between the two posterior radials, and that at a far later period, towards the close of the Palæozoic, it gradually passed upwards again, precisely as it does in the young *Antedon*, and eventually disappeared. The ontogenetic stages of the anal plate in *Antedon* are represented in the phylogenetic series by *Ceriocrinus*, *Erisocrinus* and *Stemmatocrinus*. Mr. Hurst is bound to suppose that such forms as *Merocrinus* and *Dendrocrinus* started with an anal plate in a line with the radials, a supposition contrary to all available evidence, or that the anal plate in *Antedon*, together with the remarkable changes that it passes through, is a special larval development. "Mystical" it may be, to suppose that we have here an epitome of the ancestral history, but Mr. Hurst can hardly say that it is not justified by evidence.

There are many other curious parallelisms between the growth of *Antedon* and the history of the earlier crinoids. It is, however, possible to explain them on Mr. Hurst's plan, so I merely allude to them here to show that they do not in any way run counter to the Recapitulation Theory. They are the large size of the basals, the peculiar shape of the radials, the well-developed orals, and the evolution of pinnules.

To turn to another passage and to a different group of animals. At the bottom of page 197 Mr. Hurst says: "In order to produce a 'record,' it is necessary that new chapters be added at the end of the pre-existing record. It is necessary that, as the adult structure varies in one direction, the late stages of development shall vary in another, so as to become, not more like the new adult structure than they were before, but more like the old one." This is hardly a fair statement of the case. It is not correct to say that the late stages of development must vary in *another* direction; for it surely is the case, in any series of parents and offspring, which are varying in a given direction, and which we may denote A^1, A^2, A^3, A^n, that A^6 is nearer to A^7 than A^5 is. Consequently, if the latest stage of development of the form A^7 resembles A^6, it is necessarily more like A^7 than a stage which resembled A^5. That is to say, on the Recapitulation Theory, the stages of development vary in the *same* direction as the adults. Mr. Hurst's statement of the method of variation, demanded by the Recapitulation Theory, should, therefore, be amended as follows:—Variation, or change from parent to offspring, takes place by the addition of features at the end of the ontogeny; and these features are, by subsequent successive additions, gradually pushed back to earlier stages of ontogeny, so that what is the ultimate stage of one form is the penultimate of the next, and the ante-penultimate of the next after that.

Although the adherents of the Recapitulation Theory will doubtless accept the above as, in the main, a correct statement of the

method of development, yet not the most sanguine of them will hope to find so perfect an epitome of phylogeny in the majority of cases. The necessary compression, the constant elimination of unnecessary stages, the modifications required by larval conditions—all these things make it truly remarkable that we should get as much recapitulation as we do. Yes, we do get it, and this is "the way in which it does actually occur," let Mr. Hurst deny it as much as he pleases. In fact, no more perfect example of this impossible and non-existent method of development could be imagined than that which is actually afforded us by the palæontological history of the Ammonites. Does Mr. Hurst dispute the reality of the facts made known to us by Würtenberger, Waagen, Branco, Hyatt, Buckman, and many others? Not everyone will accept the alterations in classification proposed by these workers, but no one has hitherto been found to deny their facts. The reason why no one has done so is obvious: anyone can verify them for himself. It has been shown over and over again, by workers approaching the subject quite independently and from different points of view, that the adolescent stage of any species of Ammonite resembles the adult stage of its immediate ancestor, and that the larval stage resembles the adult of a previous ancestor; while, on the other hand, the senile stages of the same species foreshadow the features of the adult offspring. These facts have not merely been worked out by students in museums, by dissection of well-preserved individuals, and comparison of large quantities of specimens, but have been confirmed by minute labours in the rocks themselves, and by the careful tracing of the species from zone to zone over large tracts of country.

A suitable example is presented by the descent of *Coroniceras trigonatum* from a smooth ancestor, as indicated in Hyatt's "Genesis of the Arietidæ," Summary-plate xii. Hyatt here gives the ancestry as follows:—*C. trigonatum*, *C. gmuendense*, *C. lyra*, *C. rotiforme*, *C. sauzeanum*, *C. kridion*, *Arnioceras kridioides*, *A. semicostatum*, and *Psiloceras planorbe*, var. *leve*. To obtain an independent opinion, I applied to my friend, Mr. S. S. Buckman, who informs me that he agrees with the first six names except as to the interposition of *C. sauzeanum*. He, however, "would not like to say that the species of *Arnioceras* are the actual ancestors; but they are the morphological equivalents undoubtedly of those ancestors." There is also considerable objection to taking a retrogressive type like *Psiloceras planorbe* as the starting point of a new series. At the same time, even those who refuse to regard this particular species in the same light as Professor Hyatt, will admit that the ancestor must have been a somewhat similar smooth, keelless, and round-sectioned form; in fact, Buckman favours *Arnioceras miserabile*, which Hyatt himself gives as an ancestral form. Accepting, then, this line of descent, we may draw up the accompanying table, which traces the development of three main characters in both ontogeny and phylogeny. The first column describes the infantine stage, the second the adolescent, and the

third the adult of each species. In none of these is the embryonic stage given, since it varies very little, being of the same smooth character throughout. It becomes, therefore, interesting to learn how Mr. Hurst explains the tuberculate infantine stage of *C. trigonatum*, which is certainly considerably less like its own adult than is the corresponding stage of *C. lyra;* it cannot possibly be explained as an attempt of the embryo to become like the adult. Indeed the whole table, the facts of which are given in full detail in Hyatt's monograph, and the main principle of which is maintained by two independent workers, is totally opposed to all Mr. Hurst's contentions. It should also be remembered that there are many details of structure, too complicated to be dwelt on here, but all confirming the other evidence.

	Infantine.	Adolescent.	Adult.
Coroniceras trigonatum	Well-marked ribs and slight tubercles. Quadrate section. Keel?	Broad ribs. Section unknown. Slight keel.	Nearly smooth. Subtriangular section. Very slight keel.
C. gmuendense ...	Well-marked ribs and slight tubercles. Subquadrate section. Slight keel.	Clear ribs and slight tubercles. Compressed quadrate. Keel.	Slight ribs. Compressed quadrate. Pronounced keel.
C. lyra	Ribs and slight tubercles. Broad subquadrate section. Slight keel.	Ribs and tubercles. Subquadrate section. Slight keel.	Tubercles. Slightly compressed subquadrate section. Keel.
C. rotiforme	Smooth, and then slight ribs. Roundish section. Very slight keel.	Ribs and tubercles. Broad subquadrate. Slight keel.	Pronounced tubercles. Subquadrate section. Keel.
C. kridion...	Almost smooth. Broad rounded section. No keel.	Slight ribs. Broad subquadrate section. Slight keel.	Tubercles. Subquadrate section. Keel.
Arnioceras semicostatum	Smooth. Roundish section. No keel.	Smooth and slight folds. Elliptical section. Trace of keel.	Slight ribs. Slightly broader section. Slight keel.
A. miserabile.	Smooth. Round section. No keel.	Smooth. Slightly compressed round section. No keel.	Smooth. Elliptical section. Slight keel.

Professor Huxley once said that if Evolution had not already been an accepted theory, the palæontologists would have had to have invented it. It might, with no less truth, be asserted that, if the embryologists had not forestalled them, the palæontologists would have had to invent the theory of Recapitulation. As a matter of fact, many of them seem actually to have arrived at it quite independently either of one another or of the neontologists, a circumstance that does not necessarily prove the truth of the theory, but that should, at least, have led Mr. Hurst to pay some attention to their opinions. With evidence such as has just been quoted before them, it would, indeed, have been difficult to have arrived at other conclusions; at the same time, it must not be supposed that all lines of descent, even among Ammonites, show the facts with equal clearness. There are, as has already been hinted, many modifying forces at work, and the chief of these may be conveniently included under the one head of economy. To this is due the disappearance from the record of those features that are not adapted to the needs of the animal in the early

stages of its life, and of those that involve unnecessary expenditure, such as a spinous stage in an Ammonite intervening between two costate stages. These explanations of the falsification of the epitome are barely alluded to by Mr. Hurst; for since, on *à priori* grounds, he denies any epitome whatsoever, he naturally does not stay to enquire whether he may not have sometimes been misled by these obscurations of it. So far, then, as Mr. Hurst is concerned, it is idle to discuss these matters, we must rather seek for flaws in his original argument.

His main fallacy appears to me to be simply this, that he substitutes contemporary relations for ancestors. After stating Von Baer's law, which obviously refers to existing species, co-existing, that is, and therefore not derived the one from the other, he proceeds to say:—"If similar comparisons could be instituted between an ancestral species and its much modified descendants, there is no reason for doubting that a similar result would be reached." But there is all the difference in the world between filial and fraternal relationship, and though Von Baer's law is undoubtedly true of the latter, there are many objections to supposing that it is equally true of the former. The only evidence that Mr. Hurst condescends to offer is the quotation from Darwin, which is, indeed, one part in favour of himself, but the other six parts in favour of his opponents.

Mr. Hurst seems to suppose that on the Recapitulation Theory a bird should begin life as a fish, then change to a lizard or other reptile, and finally burst into a bird. Such a harlequinade has never been imagined. The bird of to-day must be compared, not with the reptile of to-day, but with the bird of the past, and that in its turn with a form which may have had very few of the characters of reptiles as we now know them; as for fish, it is as likely as not that they barely entered into the phylogeny at all. Those who keep a more observant eye on the progress of vertebrate palæontology than I have leisure to do must surely have observed how day by day the ancestral stocks are pushed further and further back, so that the connecting link between, or common ancestor of, the great divisions cannot possibly be dragged into the discussion.

To glance at another example of Mr. Hurst's—the three gnats *Culex*, *Corethra*, and *Chironomus*, forms which, though alike in the adult, are dissimilar in the larval stage. Of course, it is possible that these genera may really be descended from a common ancestor, and that variation has chiefly affected the early stages. If so, it is clearly impossible that those early stages can reveal to us the past history of the genera in question. Such cases as this are admitted by everyone; they are consistent with the Recapitulation Theory, and as Mr. Hurst makes no further capital out of them, it is hard to see why he introduced them at all. On the other hand, instances are known, as in the Ammonites *Dumortieria* and *Grammoceras*, of adults which resemble one another so closely that they would actually be taken for

the same species, did not investigation of their ontogeny reveal stages resembling the adults of pre-existing species belonging to the two different genera. In these cases, it is the earliest stages that differ most and afford the best proof not only as to their affinities with contemporary species, but as to their perished ancestry. It would be rash for one who is no entomologist to hint that the resemblance of the adult *Culex*, *Corethra*, and *Chironomus* is a similar case of convergence; but it is clear in the case of *Dumortieria* and *Grammoceras* that "variation" apparently "affecting chiefly the structure of the individual in early stages of development" has actually preserved to us a record of the ontogeny.

Another mistake of Mr. Hurst, is his refusal to admit more than one method of variation. He appears to deny that variation occurs at the close of ontogeny; if an adult structure varies, he says in effect, it ceases to exist as an adult structure at all. It does eventually do so, no doubt, but not immediately. The very same "change in the constitution of successive generations of a species leading to the production of a new species" does take place in the life-history of a single generation. Ontogeny, in fact, forecasts phylogeny just as much as it repeats it. An Ammonite that is smooth in the adult, will become ribbed in old age; this change takes place at earlier and earlier periods in successive generations, till at last a form is attained that has ribs in the adult. Then we call it a new species. But this new species is spinous in its old age; gradually do the spines, in like manner, appear sooner and sooner, till another species, that bears spines in its maturity, is found in the rocks. A similar case is the tendency of modern civilised man to adopt baldness as an adult character, although one that has hitherto been regarded as purely senile. Yet all these well-known instances of variation (and I use the term precisely in Mr. Hurst's own sense) "occur in a way utterly unlike the way in which it does actually occur," *i.e.*, within Mr. Hurst's horizon. Of course, this is not the only method of variation; there are sports of differing degrees, and there is variation produced by sexual mixture of different strains. If these alone were to be considered, we might, of course, be led to different conclusions, that is, if we were persistently to shut our eyes to the plain facts of palæontology.

The fact that absurdities and contradictions have arisen from too zealous following of the Recapitulation Theory does not actually prove the conception false; nor, on the other hand, does the fact that under its guidance we have made remarkable discoveries and initiated fruitful investigations necessarily prove its truth; at the same time, it might possibly lead Mr. Hurst to reconsider his condemnation if he were to make himself acquainted with the brilliant researches of Hyatt and Buckman on Cephalopoda, R. T. Jackson on Pelecypoda, and Beecher on Brachiopoda, not to mention many writings in other tongues than our own, all which works have been inspired by the Recapitulation Theory.

F. A. Bather.

IV.

Ornithology in Relation to Agriculture and Horticulture.[1]

THE subject of agricultural and horticultural economics, considered in the relations of birds and insects to the produce of the soil, is one which, till recent years, has been singularly neglected in this country. In France, Belgium, and especially in America, as well as in other civilised countries, the most careful and practical investigations, under the assistance of the State, have led to the accumulation and diffusion of much valuable information on this and kindred subjects. In England, the researches of Miss Eleanor A. Ormerod (late consulting Entomologist to the Royal Agricultural Society of England) are recognised as of great value in enabling the farmer and gardener to detect the various insect pests which take tithe of his crops, and in teaching him how best to apply suitable remedies for their prevention or extirpation.

In the present volume the editor, Mr. John Watson, has brought together a series of useful papers and notes by various naturalists, whose names are a sufficient guarantee of the high practical value of the opinions expressed, in connection with ornithology in its bearings on agriculture and horticulture. On taking up the book we are somewhat disappointed to find that it contains neither preface nor introduction stating under what circumstances the various papers were written, we can only conclude, therefore, that these have already appeared either as newspaper articles or in some serial. The book is divided into twelve chapters, under the various headings of Hawks and Falcons, Owls, Wood-Pigeon, Rook, Starling, Miscellaneous Small Birds, Game Birds, and an appendix, with notes and additions. No less than five chapters are devoted to the sparrow, those "rats of the air," "ruffians in feathers," whose mischievous and destructive character are recognised and acknowledged by farmers and gardeners over half the world.

The larger birds of prey, buzzards, kites, goshawks, harriers, and the noble peregrine are now virtually extirpated in England, and

[1] Ornithology in Relation to Agriculture and Horticulture. By various Writers. Edited by John Watson, F.L.S., &c. London: W. H. Allen & Co., 1893.

the smaller hawks and falcons, and also owls, are far less numerous than formerly. There are at present large districts in England where you may wander all day without seeing a single bird of prey. This has been brought about by the excessive rage for game-preserving. As a class, gamekeepers, considering the great opportunities at their disposal, are proverbially ignorant of Natural History, and seem quite incapable or unwilling to discriminate, even from their own narrow standpoint, between the good and the bad. The natural result, therefore, of so much misplaced zeal has been an enormous increase in wood-pigeons, sparrows, rats, and mice, which, now that their natural enemies, the birds of prey and weasels, have been destroyed, flourish and multiply unchecked, and yearly destroy great quantities of valuable cereals and other farm and garden produce.

So much has already been written in defence of the farmers' best friends, the owls, that any further allusion to the subject would only be hackneyed and out of place. We will only, therefore, mention one fresh fact in proof of the value of the owl as a vermin-destroyer. In the vole-plague districts of the south of Scotland, which includes a wide area of hill-pasture in Teviot and Hawick, Ettrick, Eskdalemuir, Yarrow, and Moffat, in 1892, 301 nests of the short-eared owl (*Asio accipitrinus*) were actually found on those farms from which specific information was obtained, and it is calculated that this number may be reasonably doubled to include those not seen.

The result is 602 nests, with, say, seven young to each nest, equal to 4,214 young birds on these farms. These owls have undoubtedly been attracted to the district from great distances by the enormous supply of their natural food, and are induced to remain and nest there, and the services rendered by them to the sheep farmers cannot well be estimated. To give three instances alone, twenty-nine dead voles were taken from the side of one nest, and the next day twenty-seven from the same place. In another case, a shepherd counted thirty-seven at a nest containing ten eggs. For some years past the short-eared owls are known to have nested in small numbers in the infected area, but in 1892, owing to the abundance of food, they have mustered, remained, and bred in extraordinary numbers, with the result that there has been a marked diminution of the voles over much of the districts named. The mouse-eating kestrel has also greatly increased since the commencement of the plague, and as many as thirty have been seen at one time. The whole question has been most ably treated by Mr. Peter Adair in a paper which appeared in "The Annals of Scottish Natural History" for October, 1892.

In the five chapters relating to the sparrow, the evidence for the prosecution greatly outweighs that for the defence. It is clearly shown that the depredations of this pest, on fruit-tree buds, to fruit farmers, florists, young crops of vegetables, and more especially to corn in autumn, is enormous, and far in excess of any benefits con-

ferred by the consumption of injurious seeds and noxious insects. They entail also direct harmful consequences by their pugnacious and self-assertive nature in driving off useful insectivorous birds from the neighbourhood of their haunts. Yet it is by no means clearly proved that an utter and complete extermination of the sparrow-nuisance would be a benefit, for when man upsets the balance of nature, he very often has to pay for it in some form or other.

The sparrow certainly requires no Act of Parliament to protect him, and the plea of sentimentalists and humanitarians that he should be allowed to increase and multiply unchecked, will certainly never be listened to by those country folk who are best able to form a judgment in the matter.

There can be no doubt that, during the last half-century, the woodpigeon or ringdove (*Columba palumbus*) has increased to an enormous extent. The causes of this increase are, doubtless, the killing off of the falcons and hawks, which are the natural enemies of the race, the increase of woods and plantations, especially those of fir, and the abundance of winter food in turnips and other green crops. It is quite certain, too, that in the autumn the ranks of our local birds are greatly increased by immigrants from the Continent. In the autumn, woodpigeons congregate and attack the ripening corn, particularly in those spots where it is storm-laid, devouring great quantities, and crushing and trampling the heads to near the ground, so that in a wet season much becomes hopelessly sprouted. In winter they commit serious ravages in the turnip crops by eating the leaves, thus exposing the bulb to frost. They are also very partial to the young clover plant. The ringdove, however, has redeeming points, its plaintive coo, rōō, coo, coo is a pleasant sound at early morning in spring woodlands, and in the winter it is a real sporting bird, and excellent eating.

The injury done by rooks has often been much exaggerated by farmers and others. If we put aside those periods of the year when it levies contributions on the newly-sown corn, especially when badly covered, the time when the corn is ripening, injury done to stacks and swede turnips in severe weather—we have pretty well enumerated all the charges brought against him. All the rest of the year he is ridding the pastures of injurious grubs, such as the larvæ of the cockchafer (*Melolantha*), and of the cranefly (*Tipula*). In recent years, rooks, in those districts where they are too many, or short of food in a drought, have been accused of developing egg-stealing propensities, and harrying the nests of game birds and wild fowl, and killing the young, and we are afraid he is not altogether guiltless in this respect.

The starling, considered from an agricultural point, is the greatest possible friend both of farmer and gardener, its food during the whole of the year consisting of grubs, small molluscs, worms, and insects, and only very occasionally fruit and berries. In the autumn immense flights of migrating starlings come to us from the Continent;

these are an Eastern race, distinct from our common bird, and have purple heads and green ear-coverts, and they leave the country in the spring.

We are somewhat doubtful as to what Mr. Riley Fortune tells us in chap. x., that the starling picks the "ticks" from the wool on the backs of sheep. We rather think he uses the sheep's back as a convenient perch. At various times we have watched them through a glass at a short distance, when perched on the backs of thick-wooled Lincoln sheep, but have never seen them actually picking off the sheep fags.

Much more might well be written on this most interesting topic, the subject is practically an inexhaustible one. Out of the multitude of our miscellaneous small birds, the greater part are absolutely innocuous and are largely beneficial. In other cases, the injury done at certain seasons is slight and amply counterbalanced by the services they render during the rest of the year in destroying insects and the seeds of weeds.

In conclusion, to sum up the evidence both for and against, as placed before us by the able ornithologists in Mr. Watson's book, it is abundantly apparent that the case for the prosecution falls very far short of the defence, and that the verdict must be an acquittal for the birds, both as regarding individual species and in the aggregate, with an admission that the benefit they confer upon man is far in excess of the injury. There is one exception to this, and that is the ubiquitous and all-devouring sparrow.

"O wretched set of sparrows, one and all,"—

Perhaps no greater mischief is done than by that large class of sentimental writers who are ever ready to exaggerate the good qualities of their feathered favourites and to minimise the evil. It must, however, be apparent to the dullest intellect that no wild bird is able to draw a line between the natural production of the soil and those seeds and fruit which are the results of man's industry. Neither can it be expected that hawk or falcon can discriminate between the young of a wild bird and a coop-reared pheasant or partridge. In so highly a cultivated country as England, birds would often be put to great straits if they had to depend on wild fruits or seeds alone, and, having dispossessed them of their inheritance, we must be satisfied to give our little workers some small share of our produce as a return for the important services rendered in keeping down weeds and insects, and thus indirectly helping to increase the fertility and productiveness of the soil.

JOHN CORDEAUX.

V.

A Fish-Eating Rodent.

A VERY interesting new Mammal has recently been received at the British Museum, in the form of a Fish-eating Rat from the mountain streams of Central Peru. The animal is of about the size of a common house-rat, but has a flattened head, strong and numerous whisker-bristles, and very small eyes and ears, characters which give it a striking resemblance in its physiognomy to some of the aquatic genera of the Insectivora and Carnivora, such as *Potamogale*, *Myogale*, *Lutra*, or *Cynogale*. Its swimming powers are evidently very great, as is shown, among other things, by its broad, webbed and strongly-ciliated hind feet, far better developed for this purpose than are those of the ordinary swimming Muridæ, such as our English Water-vole, whose simple vegetarian diet does not necessitate the development of any exceptional swimming powers. In colour, like the common Water Shrew, it has a dark upper side with a whitish belly, and has a markedly bicolor black and white tail.

The chief interest of the new form centres in the fact of its being wholly a fish-eater, and in its having in connection therewith its incisor teeth modified for catching a slippery, active prey by the development of their outer corners into long sharp points, and its intestines altered by the reduction almost to *nil* of its cœcum, an organ in vegetarian Muridæ always of great size and capacity. The stomach of the single specimen obtained contains fish-scales, recognised by Mr. Boulenger as those of *Tetragonopterus alosa*, a fish whose average length is about six inches.

This animal represents quite a new departure in Rodent life-history, for although it is now perfectly well known that the North American Musquash (*Fiber zibethicus*) occasionally feeds on fish caught by itself, yet there is no other Rodent which, as in the case of *Ichthyomys stolzmanni*, as it is proposed to term the new form, wholly lives on fish, to the exclusion of a vegetable diet.

The general relationships of *Ichthyomys* are clearly with the ordinary South American Muridæ, perhaps more especially with those of the *Habrothrix* group, and there is certainly no direct connection with *Fiber*.

The type and only known specimen of this interesting form was obtained by the Polish collector, Mr. J. Kalinowski, at Chanchamayo, Central Peru, in the course of 1891.

OLDFIELD THOMAS.

VI.

Colour Changes in Insects.

THE question of the variation in colour and markings exhibited by many species of lepidoptera, in both their preparatory and perfect stages, has, during the last few years, received much attention, and given rise to not a little controversy. A general protective resemblance of insects to their surroundings has long been an accepted fact with most naturalists, and no one would deny that the special and often highly perfect likeness of caterpillars to twigs and imagines to leaves, is of value as a protection; but on the meaning of the variation in colour of a species with reference to its surroundings, less certainty has existed. This most interesting subject was brought into prominent and public notice in 1890, by Poulton, in his well-known book, "The Colours of Animals" (pp. 110–158). Some doubt has lately been expressed as to certain of his deductions. His recent publication (1) of the details of several years' experiments, of which only some of the leading results were given in "The Colours of Animals," is, therefore, of value, and a short review of the questions raised may be of interest.

The only larvæ of Noctuid moths on which Poulton experimented were those of *Hadena oleracea*, *Euplexia lucipara*, two species of *Mamestra* (*M. brassicæ* and *M. persicariæ*), and four of *Catocala* (*C. sponsa*, *C. nupta*, *C. fraxini*, and *C. elocata*). The *Mamestræ* showed no power of colour-adaptation, some green caterpillars of *M. persicariæ* turning brown on green leaves. Most noctuid larvæ feed by night, hiding in earth by day, and colour is consequently of minor importance to them. The *Catocala* larvæ, which in their form and habits approach geometers, were rather sensitive to environment, tending to become darker when black twigs were mixed with their food, than when among green leaves and shoots only. Poulton's results with these two genera are confirmed by Miss Gould (2). No certain results were obtained with the larvæ of *Hadena* and *Euplexia*.

The only geometrid caterpillar which was not proved sensitive to its environment was that of *Ephyra annulata* (*omicronaria*). All others on which experiments were made were darkened by placing black twigs among their food. Such were the larvæ of *Ennomos quercinaria* (*angularia*), *Selenia lunaria*, *Melanippe montanata*, *Phigalia pedaria* (*pilosaria*), *Hemerophylla abruptaria*, and *Crocallis elinguaria*. All these were light brown among green leaves and shoots. The last-named caterpillars were

placed among green leaves in darkness, and were darkened thereby, though not nearly so strongly as by dark surroundings in daylight. The larvæ of *Geometra papilionaria*, which hibernate, were sensitive before the winter, when various shades of brown in colour; in the spring, however, when they become dimorphic, brown or green, they were found to be no longer sensitive. The caterpillars of *Boarmia roboraria* were, before hibernation, dark grey or brown in a dark environment, and greenish among green leaves.

Still more satisfactory results were obtained with caterpillars of *Rumia cratægata*. These were dark brown among black twigs, and light brown with green patches among green leaves. Miss Gould (2) also obtained similar results with this species. A striking experiment by Poulton in the subsequent year seemed to show that there is no tendency of these acquired colours to be inherited; indeed, the caterpillars from eggs laid by moths reared from the darker caterpillars were more easily affected by green surroundings than by dark; while the offspring of moths reared from the lighter larvæ were more sensitive to dark surroundings than to green.

But the most remarkable results were given by caterpillars of *Amphidasys betularia*. These were nearly all dark when many dark twigs were placed with the food, mostly dark when some twigs were inserted, and all green when no twigs were used. The presence of white paper spills caused the larvæ to assume a remarkable whitish hue. In 1892, Poulton carried out a more detailed series of experiments on this species. Caterpillars among black twigs were found to be nearly or quite black, those among brown twigs were brown, those among dead leaves were mottled-brown with vein-like markings. Artificial dark surroundings (black paper or enamel) caused the larvæ to be dark, but were not so effective as the twigs. Dark objects not in contact with the larvæ (piled around the cylinders containing the food) had no effect. Among green leaves and shoots only, the larvæ always turned green (the early stages are always brown), except when they were much crowded, in which case they had rather a darkening effect on each other; it appears that dark surroundings act more readily than green. With dark and green environment in feeble light, similar results were obtained to some extent, but the differences were by no means so marked as in daylight. In darkness, no difference was produced, whatever the surroundings, the caterpillars being always black, brown, or grey of various shades. The presence of blue paper spills caused the larvæ to assume a dark purplish hue, while orange paper among the food leaves produced a green colour in the caterpillars.

Poulton has shown that the dark pigments (to which the various shades of brown, black, grey, etc., are due) are deposited in the cells of the epidermis, while the green colouring-matter is found in the subjacent fat. The presence or absence of both sorts of pigment is determined by the surrounding objects, through some quality in the

light reflected from them. The suppression of the superficial dark pigment thus leads to the green colour of the caterpillar.

From these experiments, the fact that geometrid larvæ have a very considerable power of colour-adaptation to their environment appears to be beyond dispute. There seems no reason to doubt that this power is of considerable protective value to the insects, especially when we consider that the larvæ in which it is developed are all of a form closely resembling the twigs of their food-plants, but that they need some power of colour-adaptation to render the resemblance perfect. Poulton lays stress on the fact that all the numerous varieties of *A. betularia* produced by the experiments would be in correspondence with some possible natural environment. The experiment of moving caterpillars from one set of conditions to another showed that the early larval stages only are susceptible to any great extent; after the last moult but one, little or no change was produced. Hence, the most sensitive caterpillar has not that power of changing and rechanging its hues which is possessed by many fishes and reptiles; but then, in natural conditions, the environment of caterpillars will very rarely be changed.

In "The Colours of Animals," Poulton gave several instances of variation in the colour of the cocoons spun by caterpillars before pupation, which appeared to correspond to changes in the environment. The cocoons of *Saturnia pavonia* (*carpini*), *Eriogaster lanestris*, and *Halias prasinana* were found to be brown among leaves, and white in paper bags. Bateson (3, 4) has, however, now shown that the white cocoons of the two former species are not due to the colour of the surroundings, but to the disturbance of the larvæ before spinning. Caterpillars which were removed from their food, when ready to spin, produced white cocoons whether placed in dark or light bags, while when white strips of paper were placed about the food, without disturbing the larvæ, they spun dark cocoons. Bateson has further established that the dark hue of the cocoons is due to a brown fluid contained in the alimentary canal, with which the caterpillar colours the silk as it is discharged from the mouth, perhaps, also, staining the finished cocoon by an ejection from the intestine. When a caterpillar is disturbed, this fluid is voided before spinning, and hence the cocoon is white. Tutt has discovered (5) a similar cause for the varying colours of the cocoons of *Halias chlorana*, which, however, do vary in hue with their surroundings to some extent. Poulton has now made further experiments on *H. prasinana*, and, carefully avoiding disturbing the larvæ, finds that the cocoons of this species do vary in accord with the colour of the surroundings. The caterpillars seem to exercise choice in the colour of the silk they produce, and to be less irritable than those of *Saturnia pavonia* and *Eriogaster lanestris*. A larva which had begun to spin a white cocoon in a chip box was removed, an attempt was made to cut out the egg of an ichneumon, and the caterpillar was injured thereby.

Nevertheless, this insect, when placed among oak leaves and twigs, spun a dark cocoon! Such difference in behaviour in different species should guard observers in future against too hasty generalisation.

Poulton's recent experiments on butterfly pupæ confirm the results given in "The Colours of Animals." The most striking effects were obtained with *Vanessa urticæ* and *V. io*. These chrysalids vary from dark brown or black to bright golden (*urticæ*) or metallic green (*io*). As in the larvæ, the latter effects are due to the absence of dark superficial pigment, and are produced by light, or bright metallic surrounding surfaces. As with the larvæ, dark surfaces lead to the formation of the dark pigment. The pupal colour is fixed in *V. urticæ* by the surroundings of the larva when in the early stages preparatory to pupation, wandering in search of a suitable spot for attachment, or resting motionless before attachment. These stages are lengthened by dark surroundings, and also by disturbance; Poulton believes that during them the "colourless precursor" of the dark pigment which will appear in the pupa is being formed. The last stage of *V. urticæ*, after the caterpillar has suspended itself, is not sensitive, and little or no effect is produced by changing the surroundings then; but in *V. io* this stage is longer, and some result can be obtained by transferring the insects to a different environment.

Caterpillars of *V. urticæ* placed in a gilt cylinder in darkness changed to dark pupæ. Dark surroundings, in a strong light, produced slightly greater darkening of the pupæ than the same environment in the dark. Some larvæ were allowed to pupate in boxes lined with alternate strips of black and gold paper, so that the insect in its motionless stage rested partly on black and partly on gold. These produced pupæ of an intermediate tint, but none were parti-coloured. As the position of the head made no difference in the result, it seems certain that the colour seen by the caterpillar has nothing to do with the effect.

Many experiments besides simple dark and bright surroundings were tried with *V. io*. The larvæ, when exposed to blue light, produced darkish pupæ; when placed on orange and yellow backgrounds, bright green pupæ. Chrysalids of intermediate tints were formed amid bright green surroundings. Dark green surroundings and red paper backgrounds led to dark pupæ, but light falling through green glass, or through red glass or gelatine, made the pupæ light or bright green. When the pupæ were exposed to black ventrally, and to white dorsally, or *vice versâ*, the effect of the dark surface was stronger than that of the white.

The nature of the light-rays reflected from or transmitted through the various substances used, was tested by careful spectral analysis, and it appears that the presence of yellow and orange rays checks the formation of dark pigment, and tends to produce light, green, or bright larvæ and pupæ. The difference between the results with green

leaves and with certain green pigments is thus explicable; the light reflected from the leaves possesses yellow rays, and, consequently, produces light effects on the insects, while the green pigments absorb these rays. So also the red paper backgrounds absorb the rays and produce dark effects, but red glass or gelatine transmits the rays and causes green or light colour in the insects. Petersen (6) seems to have independently arrived at similar results, and to have given the same explanation of them.

The only imagine made the subject of experiment by Poulton was *Gnophos obscuraria*. This moth is mentioned in "The Colours of Animals" as being commonly light on chalk and dark on peat. A number of these insects were reared from the egg, some amid dark, others amid light surroundings, but in no stage was the colour of the insect affected by its environment, and the moths all turned out a light-grey hue. Poulton is led, therefore, to suggest that the prevalence of varieties in nature appropriate to the soil where they occur is the result of natural selection.

The cause of the darkening of moths in various localities has been for several years past frequently discussed, and numerous theories have been propounded. Lepidopterists have noticed that British moths are, as a rule, darker than specimens from the Continent, and that, within the British isles, western, northern, and mountain varieties are darker than insects from the southern and eastern lowlands, the melanic tendency being most strongly marked on the west coast of Ireland, and in the northern and western islands and highlands of Scotland. Yorkshire naturalists have noticed also a special tendency to melanism near the large manufacturing towns of the north, and the dark varieties are said to be increasing, while the lighter types are dying out. It has been suggested that the darkening is, in this case, due to the soot which the unhappy larvæ are compelled to eat with their food!

Natural selection, moisture, cold, and the absence of sunlight, have been put forward as serious suggestions for the cause of melanism. The districts where the phenomenon is most marked are the wettest in the country, and it is evident that constant moisture tends to render dark most objects on which insects rest, and so to favour dark varieties. Natural selection would therefore tend to the preservation of melanic moths in moist districts, but the general impression is that something in moist districts tends also to the production of such varieties. Tutt (7) and many other naturalists, consider moisture of itself to be a cause of melanism. Merrifield believes low temperature to be effective in the same direction, and has, during the last few years, conducted numerous experiments on the effect of temperature in producing dark colouration (8, 9) analogous to the well-known experiments of Weismann. By cooling the pupæ of *Selenia illustraria* (summer brood) and *Ennomos autumnaria*, he has obtained striking results, the moths being rendered decidedly

dark, those of the former species approximating to insects of the spring brood, which are normally dark. He has also succeeded in producing very dark examples of *Lasiocampa quercus*, by cooling the pupæ, and very light specimens of its northern dark variety, *callunæ*, by heating the pupæ (10). In these and other species, there seems no reason to doubt that low temperature applied to the pupæ does induce darkening of the imagine. On the other hand, the upholders of the moisture theory deny that there is such a general darkening of lepidoptera in arctic latitudes as should exist if low temperature be the main cause of melanism, and insist that the climate of the districts where melanism prevails is often mild and equable. This is true, but the summer temperature of these regions is lower than that of southern England, and much lower than that of Continental Europe. It is very possible that moisture may be a true cause of darkening; careful experiment might go far to settle the matter. It seems clear, however, that moisture or cold, or both, tend to the production of melanic varieties, and that these varieties, when produced, are specially favoured by natural selection.

Such observations have been made on few insects except Lepidoptera. There are, however, instances of melanism in Coleoptera. My friend, Mr. H. K. Gore Cuthbert, informs me that in Irish specimens of the beetles, *Badister bipustulatus*, *Dromius quadrinotatus*, *Nebria complanata*, and *Agabus guttatus*, the pale spots and markings are generally smaller than in English examples. A small ground beetle, *Calathus melanocephalus*, with red pronotum, has, in mountainous regions, the pronotum clouded with black (var. *nubigena*). I have lately received this variety (which is considered a rarity in England) from the Aran Isles, in Galway Bay, but little above sea level, and also from the Faroës. This is a good indication of the similar darkening effects produced in mountain, western, and northern regions.[1]

Specimens of the common wheel-web spider, *Epeira diademata*, which I have received from the Aran Isles, also show the same darkening tendency. The large conspicuous white spots in form of a cross, so characteristic of typical examples of this spider, are reduced in these western individuals to small dots. A similar, but less marked, variation is to be noted in specimens from co. Donegal.

Observations on this spider have furnished me also with a few facts bearing on the subject discussed in the earlier part of this review. The ground colour of the abdomen is well-known to vary from light brown through various shades of brown and red to a nearly black hue. Among granite rocks I have always found the latter variety; as it crouches in its retreat in a crevice of the rock, its black and white markings harmonise admirably with the mica and white felspar of the granite; but among herbage, the red and brown varieties are the more common. Whether this correspondence

[1] On the other hand, the black carrion beetle, *Silpha atrata*, is represented in Ireland by the var. *subrotundata*, which is generally of a brown colour.

be due entirely to the action of natural selection, or to some direct influence of the environment, experiment may perhaps decide. There can be little doubt that, to spiders, such correspondence is of "aggressive" as well as of "protective" significance.

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GEO. H. CARPENTER.

VII.

Experimental Embryology.[1]

EXPERIMENTAL Embryology is the youngest department of biological science; for although the idea of artificially influencing the germ is very old, and although even Swammerdam is said to have experimented in producing monstrosities, all the important results are very recent. They are already so important, both in themselves and in their suggestiveness, that it is imperative on every biologist to take stock of them. In part this has been already done by Weismann in his recent book on "The Germ Plasm," and by Roux, in an address delivered to the congress of the *Anatomische Gesellschaft*, held last June in Vienna; but already there are further researches of moment to be taken account of, and a fresh survey may be permitted. A critical review I do not propose to attempt, partly because that may be more profitably left to the expert embryologists, partly because it may be conveniently deferred until the body of facts has had time to become integrated.

I. Just as pathology sheds light on physiology—for instance, in the case of the thyroid gland—so teratology may help us to understand normal development. The most successful worker along this line has been M. Camille Dareste. He is the acknowledged chief of artificial teratologists. To attempt an appreciation of his results would lead us far into morphological questions; suffice it to say that he has experimented with the eggs of birds, placing them vertically instead of horizontally, hermetically varnishing part of the shell, keeping them slightly above or slightly below the normal temperature of incubation, heating different parts of the egg unequally, and so on. He has not only shown that the germ is plastic in the grip of its environment, he has been able to induce various malformations which are of interest to the student of morphology.

Dr. Bertram C. A. Windle, Professor of Anatomy in the Queen's College, Birmingham, has followed up some of Dareste's investigations, observing on the eggs of the fowl the effect of (*a*) excluding part of the air supply by varnish, (*b*) incubating under electrical current, and (*c*) incubating in the proximity of magnets. He is very cautious in his conclusions. He confirms, however, the view of Dareste that the same anomalies may be produced by diverse

[1] A Paper read before the Scottish Microscopical Society, March 10, 1893.

methods. "Whatever the disturbing agent may be which is employed, the failures of development are generally of the same nature —a consideration which, if true, as I believe, points to a much deeper explanation of the variations and malformations produced than that which attributes them to the actual deprivation of air, or whatever the means may be which is used." "I think there is now good evidence to prove that these disturbing agents act, at least in the great majority of cases, on that part of the developing organisation which is concerned with the formation of the vascular system of the embryo."

Professor O. Hertwig has recently (1892) published an elaborate essay, entitled "Urmund und Spina bifida," based on a study of abnormalities which occur in the development of frog ova in consequence of over-ripeness and polyspermy. The segmentation may be strangely irregular, large parts of the yolk may remain undivided, and the formation of the gastrula may be so disturbed that the blastopore or the primitive groove remains partially or wholly unclosed. He believes that the malformations which occur in the frog embryos in consequence of the imperfect closure of the "Urmund" are analogous to the Terata mesodidyma and katadidyma in Teleostean fishes and to Spina bifida in higher vertebrates. In the over-fertilised egg opposing factors conflict; on the one hand, there are forces tending to development and incited by the fertilisation, on the other hand, there are forces of an inhibiting and disturbing nature, due to the injury the ovum has sustained by over-maturation, or by other abnormal conditions operative before fertilisation.

II. We shall now notice some results of the important work of Dr. W. Roux. It is well-known that, in a number of types, the first three planes of segmentation in the dividing ovum correspond to the three chief planes dividing the bilaterally symmetrical adult into right and left, rostral and caudal, dorsal and ventral regions. In Amphibians and Ascidians, the first plane of segmentation in the ovum normally corresponds to the median plane of the embryo. This was shown for Amphibians by Newport, Pflüger, and Roux, and for Ascidians by E. van Beneden and Ch. Julin. Of the first two cells into which the egg of a frog develops, one has in it the material for forming the right half of the body, the other has in it the material for forming the left half of the body. It is a separate question whether each cell has, by itself, the power of forming half a body.

For a time, there was considerable difference of opinion as to the possible influence of gravity in determining the first segmentation planes. Pflüger (1883) maintained that gravity determined the arrangement of the molecules, determining, for instance, in the unsegmented ovum the position of the future nervous system or dorsal line; but Roux showed that when frog ova developed on a slowly rotating vertical wheel, so that the direction of the force of gravity was continually being changed, the segmentation remained normal. In

other words, the orientation of the ovum is regulated by internal conditions. Born reached the same conclusion by another method.

Having settled this point, Roux attacked the question whether all parts of the ovum were necessary to normal development. After two or more divisions, certain cells of the segmenting egg were pricked by a needle, so that some of the substance was lost. Thereafter, the development was watched until the embryo became differentiated. The result was that a loss of even one-sixth of the substance of the ovum produced only circumscribed local defects or disturbances. To develop fairly well, an ovum need not be intact.

Then Roux proceeded to exclude from development one of the two first segmentation cells. This was done by puncturing one cell with a hot needle. The result was that a typical half-morula, or half-gastrula, or half-embryo developed. Thus, there might be half cerebral vesicles, one auditory vesicle, a half-gut, a single row of protovertebræ, and a notochord of half the normal thickness. Sometimes, however, these half-embryos were slightly abnormal. Thus it was proved that one of the first two segmentation cells may form half an embryo; that it has not only the requisite vital material, but the requisite power; and, that it can develop apart from its neighbour. It is a likely inference that in normal development, a similar independence does to a certain degree obtain.

What is true when the first segmentation-plane corresponds to the future median one, is also true when the first plane corresponds to the future transversal, as is sometimes the case in the segmentation of frog ova. In other words, Roux was able to produce not only a right and left half-embryo, but also an anterior and a posterior half-embryo. By destroying one of the first four segmentation-cells, he was able to rear three-quarter embryos; by destroying three of the four, he got quarter-gastrulæ. Indeed, he goes the length of maintaining that the gastrulation of the frog ovum is normally a kind of mosaic work, formed in at least four vertical, independently-developing pieces.

Very remarkable is the process by which the half-embryo may form a whole by vitalising the injured half-egg which has been lying passive while the uninjured half has been developing. To this process Roux applies the term post-generation. Nuclei and, perhaps, also portions of protoplasm migrate from the uninjured side into the passive unsegmented mass; a remarkable kind of cell-division is set up; and gradually, in a peculiar manner which Roux describes, the missing half is post-generated. Quite lately, however, Roux has been able to rear an entire frog embryo from half an egg without any co-operation on the part of the other injured half.

III. Professor C. Chun observed in 1877 that when the two first segmentation-cells of a Ctenophore ovum were shaken apart, each formed a half-larva, with four ciliated ridges, four meridional vessels, and one tentacle. The half-larvæ actually became sexual, and by a process of budding, the half awanting was formed. This observation,

which was only published (through Roux) towards the end of last year, is the more interesting since Ctenophora are far removed from Amphibia. In both cases there is unequal segmentation of the ovum, and in both cases the formation of the missing half is long delayed.

IV. L. Chabry, experimenting with the ova of an Ascidian (*Ascidia aspersa*), obtained results which are, on the whole, similar to those of Roux. His method is to place the ovum in a glass tube, of almost equal diameter, and to puncture one of the first two segmentation-cells, observing it, meanwhile, under the microscope. The cell dies; the survivor forms a typical half-morula, half-gastrula, a right or a left half-larva. If the two anterior cells of the four-celled stage be destroyed, a posterior half individual results. Quarter and three-quarter forms were also obtained. Moreover, Chabry believes that he has been able to detect the cells whose descendants give rise to eye, notochord, attaching papillæ, &c. On to the sixteen-cell stage, at least, each cell has a determined destiny, it represents a definite part of the embryo; if a cell be destroyed, the defect in the larva is a definite one. It may be noted that Roux does not think Chabry's figures of half-gastrulæ really justify the title, it seems to him as if a regenerating process had already begun to operate so as to complete the embryo. There is not, however, any revitalising of the injured half-egg, for the injuries are fatal.

V. Carl Fiedler (1891) experimented with the ova of Echinoderms (especially of *Echinus microtuberculatus*), first trying the puncturing method, afterwards following the Hertwigs' method of shaking the eggs. When one of the first two segmentation-cells was punctured, so that it merely lost some of its substance, it did not die: it recovered and divided as usual, except that the cells to which it gave rise were smaller than those of the other side. The blastula was unsymmetrical, the embryo normal. But when one of the first two segmentation-cells was punctured so that the nucleus was fatally injured, the cell died; the surviving cell formed a half-morula, a half-blastula, and, perhaps, even a half-gastrula. When two cells of the four-cell stage were injured, a half-development also resulted, and that the same whatever pair of cells remained. Therefore, the first four cells are equivalent; but at the eight-celled stage this equivalence is lost, for different groups of four turn out differently.

VI. Hans Driesch (1891) also experimented with the ova of sea-urchins, pursuing the shaking method. When the first two segmentation-cells were shaken apart, one of them usually died, the survivor divided into a half-morula, as was the case in Fiedler's experiments; but the half-morula formed a closed blastula of less than the normal size. Then followed a small gastrula stage, and a minute Pluteus larva. Thus, from one of the first two segmentation-cells a normal but minute larva may develop. While Roux got half-embryos from half-an-egg, Driesch got half-sized but otherwise complete embryos.

Driesch is strongly opposed to the conception first clearly stated by His, that there exist in the germ organ-forming regions, for the marginal material of a left half-morula may become part of the median region, and eventually part of the right flank of the Pluteus. Moreover, in some cases, the first two segmentation-cells shaken apart give rise to distinct twins, or if the separation be imperfect, to double organisms, at least, to double blastulæ. In one case a double Pluteus was obtained from the imperfect separation of the halves of a blastula.

In a second paper, Driesch gives the results of further experiments on the eggs of sea-urchins (*Sphærechinus granularis* and *Echinus microtuberculatus*). Vejdovsky, in his account of the development of *Allolobophora trapezoides*—an earthworm whose eggs very frequently form twins—had suggested that the twinning was, perhaps, influenced by warmth, for it was most frequent in warm weather. This suggestion (for speculative suggestions are often valuable) prompted Driesch to try the effect of increased warmth on the developing ova of sea-urchins. The result was very striking. Almost all the eggs of *Sphærechinus* formed distinct twin blastulæ, gastrulæ, and even Plutei. In one case a connected twin gastrula was observed. The eggs of *Echinus* did not respond to the warming; and sometimes, strange to say, all the warmed eggs of *Sphærechinus* turned out single normal embryos. Still, that there is a relation between warmth and twinning seems likely.

Many experiments were made with the four-celled stage. If one cell was shaken off, or pricked to death, the three-quarters left almost always developed quite normally into Plutei. Yet the details of segmentation were of course different. To remove one of the first four cells does not hinder development to any appreciable extent.

But, more than that, an isolated cell of the four-celled stage, isolated by bursting the other three, develops as if it were still in its natural alliance. Very few of these, however, got beyond the blastula-stage, but two became Plutei. A quarter, a half, or three-quarters of the four-celled stage may therefore form a fully developed larva.

Selenka, in his studies on the development of marine Planarians, had observed that increased temperature produced deviations from the normal segmentation. This led Driesch to experiment. He found that with increased temperature the formation of smaller cells or micromeres is wholly or partially inhibited, and that in other ways the segmentation may be disturbed, but the striking fact is that slight changes in the position of the segmentation-cells, and even a modified type of segmentation, do not hinder the development of a normal organism.

Driesch proceeded to experiment on the effect of pressure, which was supplied by the weight of a cover-glass resting in part upon the ova. The nuclear spindles were disposed at right angles to the direction

of the pressure. The formation of micromeres was suppressed; the sixteen-cell stage was a plate; and yet typical Plutei were formed when the pressure was removed. In other cases, a two-layered plate of sixteen cells was formed, and yet normal Plutei resulted, a fact which seemed to Driesch definitely to contradict the conception of His that there are definite germinal areas. What should have formed one pole of the embryo formed the two sides, and what should have formed the other pole of the embryo formed both poles. In fact, the segmentation-cells of sea-urchins are on to the sixteen-cell stage markedly homogeneous, for even after a very abnormal development normal larvæ may result.

The Hertwigs have shown that when doubly-fertilised the ova of sea-urchins divide simultaneously into four. In such ova, which Driesch believed to have been doubly-fertilised, the whole rhythm of cell-division was double, so that the sixteen-cell stage was not a true sixteen-cell stage (with four micromeres) but a double eight-cell stage. But none of these forms developed.

VII. MM. Pouchet and Chabry, experimenting in 1889 with the developing eggs of sea-urchins, found that when some of the lime-salts in the sea-water were replaced by potassium or sodium oxalate, the skeleton of the larva was incomplete or entirely absent. An apology for a Pluteus with food-canal and other organs, but without skeleton, was formed, even when nine-tenths of the lime was got rid of. Further reduction of the lime inhibited all development, even gastrulation.

VIII. Following the researches of Pouchet and Chabry, the Hertwigs, and others, Herr Curt Herbst of Zürich has recently made an interesting series of experiments on the ova of sea-urchins. To the sea-water in which these were developing he added solutions of various salts, usually in the proportions of 3·8 grms. to 100 cm. of sea-water. Each experiment was checked by a control experiment in which the conditions were the same, excepting the addition of the salt-solutions. Fertilised ova were always used, to avoid the complications of polyspermy. The ova were those of *Sphærechinus granularis*, *Echinus microtuberculatus*, and *Strongylocentrotus lividus*, and in the three cases the results were practically the same.

Forty-four experiments were made in which so much of the sea-water, *e.g.*, 140 c.cm. out of 2,000 c.cm., was replaced by a 3·7 per cent. solution of KCl in ordinary water, which contained a considerable quantity of lime. So the observer had to deal with the addition of something new rather than with the removal of much lime.

The formation of the calcareous needles was delayed; when they appeared they were abnormal and always incomplete. The internal structure of the Pluteus was distinct, but the characteristic processes were small and rounded off. If there was less than 7 per cent. of the KCl solution the abnormality of the larvæ was less pronounced.

These results are not peculiar to KCl, for experiments with

KBr, KI, KNO_3, K_2SO_4, NaI, $NaNO_3$, $MgSO_4$ gave somewhat similar results. It is therefore possible by adding these salts to the sea-water to disturb the metabolic processes by which the calcareous skeleton is formed and the growth by which the peculiar Pluteus processes are formed, while the fore-, mid-, and hind-gut, the vaso-peritoneal vesicles, and the ring of cilia, develop uninfluenced.

The inhibition of the characteristic Pluteus outgrowths is interpreted by Herr Herbst as due to absence of the requisite stimulus naturally provided by the calcareous rods; for he believes, it seems to me with much likelihood, that the rods afford a stimulus to growth in those parts where they occur.

When the solutions of the added salts were made in distilled water, with the obvious result of reducing the amount of lime in the aquarium, no needles of lime were formed even by the seventeenth day, although the cells which ought to have contributed to form them were then seen arranged in their typical disposition.

Another remarkable result was the production of larvæ (gastrulæ) in which the tuft of long, stiff processes, which normally occurs at the so-called animal pole, and is probably directive, was hypertrophied into a protruding knob with small mobile cilia. This observation was made at Trieste in 1891, but it did not succeed at Naples in 1892, nor again at Trieste in 1892, a divergence which the observer accounts for by the different temperature-conditions which obtained.

But, perhaps, the most remarkable results which Herr Herbst was able to make sure of, were obtained by adding salts of Lithium to the sea-water. The normal blastula elongates, constricts into two portions—one thin-walled, the other thick-walled. They differ also in pigmentation and ciliation. Between these two primary parts a connecting region is formed. In the majority no calcareous needles appeared. Very frequently the thick-walled portion grows at the expense of the thin-walled portion, which dwindles to a mere cap. In rare cases a gut and a mouth appeared. Now, had these larvæ lived a little longer, it seems quite likely that they would have reached the Pluteus stage to which they were approximating. If so, they would have reached it by an entirely abnormal path. But, without making any suppositions, the results are remarkable enough. It seems that the thick-walled portion is nothing more nor less than the protruded archenteron—a sort of embryonic hernia ; that the thin-walled portion is the outer wall of the gastrula, and that the connecting portion is the hind-gut of the Pluteus.

It is interesting to observe that the potency of the Lithium salts decreases from the Chloride to the Iodide; in fact the potency is in inverse ratio to the molecular weight. So is it also with salts of Sodium and Potassium. The rule only applies to salts of one and the same metal.

It seems to have been this fact, taken along with researches of Hofmeister, Heidenhain, and others, that led Herr Herbst to the

conclusion, into the demonstration of which we shall not enter, that the influence on the developing ova was not directly chemical, but was due to the altered osmotic pressure of the sea-water. The changed chemical composition produces a changed osmotic pressure, this acts as a stimulus on the cells of the larva in such a way that they are diverted from their ordinary course of development.

IX. Mr. Edmund B. Wilson, of Columbia College, New York, who is well known for some valuable contributions to the embryology of Invertebrates, has recently published a preliminary account of experiments on the developing eggs of Amphioxus.

It is well known that the first stages in the development of Amphioxus are simple. The fertilised egg divides into two, into four, into eight cells, and so on until a blastula is formed whose cells are slightly larger in the lower hemisphere. By invagination the blastula becomes a gastrula.

By shaking the water in which the two-celled stages floated, Mr. Wilson produced two quite separate and independent twins of half the normal size. Each of the isolated cells segments like a normal ovum, and gives origin, through blastula and gastrula stages, to a half-sized metameric larva.

If the shaking has separated the two first segmentation-cells incompletely, double embryos—like Siamese twins—result, and also form short-lived (twenty-four hours) segmented larvæ.

Similar experiments with the four-celled stages succeeded, though development never continued long after the first appearance of metamerism. Complete isolation of the four cells resulted in four dwarf blastulæ, gastrulæ, and oval larvæ. Separation into two pairs of cells resulted in two half-sized embryos. Incomplete separation resulted in one of three types—(*a*) double embryos, (*b*) triple embryos —one twice the size of the other two—and (*c*) quadruple embryos, each a quarter size.

The eager observer proceeded to shake up the eight-celled stages, but in no case did he succeed in rearing a gastrula from an isolated unit of the eight-celled stages. Flat plates, curved plates, even one-eighth-size blastulæ were formed, but none seemed capable of full development.

This is most interesting. A unit from the four-cell stage may form an embryo, a unit from the eight-cell stage may not. "The inability to produce a complete embryo may be due either to quantitative or to qualitative limitations." Perhaps the one-eighth-cell has too little living stuff; perhaps it is already too much differentiated to regenerate the whole. We know that there is a size limit to the fragments of Hydra which will regrow an entire organism.

According to Mr. Wilson, two facts tell against supposing that the limit is quantitative. In the first place the one-eighth products swim actively, and live as long as the quarter embryos. In the second place, minute gastrulæ may be produced from two- or four-celled

stages, which are even smaller than one-eighth the normal size. These probably result either from fission of the half or quarter blastomeres, or by some fragmentation due to the shaking-up. "These minute embryos prove that a mass one-eighth the size of the normal ovum, or less, is capable of producing a gastrula," yet the one-eighth blastomeres did not.

It seems to me, however, that this is not quite conclusive; for although I am not one of those who exalt the nucleus at the expense of the cell-substance, it seems that we cannot exclude the supposition of a quantitative limit until we know more about the size and state of the nucleus (*a*) in the fraction or fragment of the two- or four-celled stage which did form a gastrula, and (*b*) in the one-eighth blastomere which did not form a gastrula. Yet, on the whole, I should agree with Mr. Wilson that the limitation is most likely to be qualitative, for by the eight-celled stage the difference between micromeres and macromeres has become pronounced. In short, the embryonic cells are beginning to be specialised.

It is very important to notice that the segmentation of the isolated blastomere of the two- or four-celled stage agrees exactly with that of the entire ovum. "The isolated blastomere develops as a unit, not as a half-unit, and the two cells to which it gives rise cannot be individually identified with those of a normal embryo-half. The development is transformed from the beginning; but in sea-urchin (Driesch) and frog (Roux) the development is at first that of an embryo-half, which subsequently, much earlier in *Echinus* than in *Rana*, gives rise to a perfect embryo by regeneration."

X. It is well-known that the entrance of a spermatozoon into an Echinoderm ovum is at once followed by the appearance of a thin enveloping membrane, which rises from the surface of the ovum and prevents the entrance of other spermatozoa. The spermatozoon which has entered influences the ovum so that others are excluded. It is not, however, certain that this membrane is really necessary for the prevention of polyspermy.

Now, the Hertwigs showed in 1887 that if unfertilised ova were placed in sea-water shaken up with chloroform, a protective membrane was formed. Herr Herbst has recently repeated the experiment, shaking up 1 c.cm. of chloroform with 50 c.cm. of sea-water. All the unfertilised ova placed in this mixture formed the protecting pellicle. He also succeeded when he used, instead of chloroform, benzol, toluol, xylol, creosote, or clove-oil, but the two last produced a pathological appearance in the cell-substance of the ova.

The protective membrane is really referable to the hyaline marginal layer of the ovum, which seems to have a greater consistence than the internal cell-substance; it has its analogue around the larval stages; in short, it is not in itself in any way remarkable. What is remarkable is the manner in which this marginal layer is deliminated and hardened after the entrance of a spermatozoon. The hardening must

be due to an influence exerted on the cell-substance by the entrant spermatozoon. The delimitation is due, according to Fol, to the coagulation of a gelatinous substance between the envelope and the ovum. The Hertwigs and Herbst have shown that the hardening and the delimitation may be artificially evoked.

Furthermore, Herr Herbst shook off the membrane from fertilised ova, and found that in a benzol mixture a second membrane was formed. He even succeeded occasionally in producing a second membrane in addition to the first in fertilised ova, and in producing two concentric membranes around unfertilised ova.

The net result of this interesting little research is to show that the conditions productive of the hardening and delimitation of the cortical layer of the ovum are to be found in the ovum itself, and are normally due to a stimulus associated with the entrance of the spermatozoon, but which may be artificially replaced by the stimulus of certain chemicals.

Yet Weismann asks us to believe that the spermatozoon has no dynamic or other than merely quantitative influence on the ovum.

There are many other recent researches which should be considered in a full discussion of experimental embryology, but I shall refer only to two more.

XI. Very striking is Boveri's experiment, on which Weismann lays great emphasis, and which one would like to see confirmed. Boveri artificially removed the nucleus from the ova of a species (A) of sea-urchin, and poured over them the spermatozoa of a related species (B). The ova, without any maternal nuclei, seemed to have their deficiencies supplied by the spermatozoa, and the larvæ which resulted had the characters of species B.

To Weismann, this case supplies direct proof of the all-importance of the nucleus in transmission. I must confess to some doubt as to the certainty with which specific characters of sea-urchins can be discriminated in the larvæ. Moreover, hybridisation has sometimes strangely one-sided results, and from the non-appearance of any maternal characters, one cannot conclude with certainty that the cell-substance is only of nutrient importance in development. Furthermore, until definite proof to the contrary is forthcoming, it seems well to continue to believe that fertilisation is due to the spermatozoon and not merely to its chromatosomes.

XII. Finally, we may refer to Heape's remarkable experiment, in which, from an Angora doe rabbit (fertilised 32 hours previously by an Angora buck) he transferred two ova into the upper end of the Fallopian tube of a Belgian doe rabbit (fertilised three hours before by a Belgian buck). When the Belgian doe gave birth, four young were Belgian, two Angoras.

A speculative discussion of some of the researches cited above will be found in Weismann's "Germ Plasm" (pp. 134–144), and to this the reader may in the meantime be referred. I prefer in this summary to leave the facts to speak for themselves.

In regard to the scientific utility of these researches in experimental embryology, it may be noted that a number of general results are very clear. (1.) There is a great deal of life in an egg. Three-quarters, a half, a quarter will in favourable conditions form a complete larva. (2.) There is no little plasticity in the germ; the segmentation may be profoundly altered, the shape of the young embryo may be greatly changed, and a new type of larva may be produced. Yet the inherited characteristics are strong, for the experiments show a marked tendency in the germ to reach a normal result even by an abnormal path. (3.) To analyse out a definite factor—say osmotic pressure—in teratogeny is beyond dispute useful, for it may help us not only to understand malformations occurring among higher vertebrates, but also to get nearer an understanding of the conditions of normal development. (4.) As everyone knows, there are few facts, or, some would say, no facts, which can at present be cited with confidence as direct evidence of the transmission of environmentally-produced variations; and Weismann's case against the possibility of acquired somatic variations specifically affecting the reproductive cells is strong enough to lead many to depreciate, except in the case of simple Protozoa and Protophyta, the direct influence of the environment as a factor in the origin of transmissible variations. Be that as it may. How many ova are there which float in the sea and in other media; these are now, as similar ova have been in the past, exposed to the influence of very complex physical and chemical conditions; that their living stuff may be greatly affected the results of experimental embryology show; it is likely that the same is true in Nature's great laboratory; and the results, being germinal, may be transmissible. We need not be in haste to exclude the direct influence of the environment from among the primary factors of evolution.

One practical application occurs to me. Many abnormalities in the segmentation of the ova of littoral animals, *e.g.*, Gasteropods, have been noticed by various zoologists. The other day, in examining the ribbons of eggs which Doris lays in such abundance on the low-tide rocks, I noticed the great frequency of twins and triplets. In some cases they seemed to preponderate. Is it not likely that an explanation may be found in the fact that the ribbons are battered to and fro by the surge? What is done in the laboratory may also occur on the shore. The shaking may separate the segmentation-cells and mechanically produce twins. This is, of course, nothing more than a suggestion, in default of the obviously necessary experimental verification, but I find an interesting confirmation in C. Chun's observation that twin Ctenophora were most abundant after stormy days.

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J. ARTHUR THOMSON.

SOME NEW BOOKS.

Éléments de Paléontologie. By Félix Bernard. Première Partie. 8vo. Pp. 528, with 266 figures. Paris: Baillière & Sons, 1893. Price 10 francs.

The position of Palæontology among the sciences is somewhat doubtful, and even a palæontologist may question its right to have a text-book at all. Do we not rather need books of the following kind?—first, a systematic zoology, embracing all creatures whether living or extinct, and arranged, according to the best modern lights, on a phylogenetic basis—a work that should illuminate the obscurities of the present by the light of the past, and show the true meaning of perished organisms by reference to their living descendants; secondly, a good stratigraphical geology, correlating, as nearly as possible, the beds of different countries, without laying undue stress on those of the author's native land, then tracing through these beds the histories of the various faunas all over the world, and, from the combined evidence, sketching out the evolution of land and sea masses from the earliest times to our own day. To such ends, at least, our endeavours are directed, and to the ultimate perfection of both these as yet unwritten books every palæontologist makes his contribution. The worth of that contribution is proportional to the amount of zoological and geological knowledge possessed by the contributor. It is idle to select from the garner of the zoologist just those facts relating to the hard parts of animals, and from the geologist's note-book such information as bears only on locality and horizon. What is a palæontologist without a knowledge of embryology, of geographical distribution, of marine life, sedimentation and currents, of some mineralogy and petrology, and of changes induced by metamorphism? And yet, even if it were possible, it would surely be absurd to collect all these diverse bits of information, however valuable, and, putting them between two bits of pasteboard, to call the whole a Text-book of Palæontology.

Nevertheless, the present dearth of competent British palæontologists—as evidenced by the failure of the Indian Survey to find other than Germans—when regarded in connection with the abundance of pure zoologists and geologists, seems to show that palæontology, in practice, if not in theory, must have its special study. Let us, then, concede that it may be convenient for the student to have his special text-book, and let us consider what it should contain. The contents may be arranged under three headings:—(i.) The general principles of the science; in other words, the principles of biology and of geology so far as they affect the history of extinct animals. (ii.) Practical aids to research, including an account of the way to collect, clean, dissect, and investigate fossils, a guide to bibliography, and hints on the working out of problems and the proper way of publishing results. (iii.) The main facts in the history of extinct animals, which should be related as to one already acquainted

with geology and with the structure of living animals. Of course the above remarks apply with equal force to plants and the students of them.

These thoughts have been suggested by a Text-book of Palæontology from the pen of Dr. F. Bernard, of which the first part has just been published. We may now examine how far it fulfils our demands.

Of the three parts to be comprised in our ideal text-book, the second is here absent, if one excepts an occasional bibliographic reference and two or three pages on fossilisation. The first part, or "Généralités," though unduly compressed into 76 pages, is exceptionally good. It is well abreast of the times, and gives a fair and well-balanced account of the many widely-differing "doxies" that constitute modern palæontology. Thus, a chapter on Palæontology and Evolution contains excellent remarks on the conception of the species and how it has been modified by palæontological investigations, on the character, methods, and causes of variation, on adaptation, correlation and parallelism, and on almost every biological theory to which a name has of late years been given. Other chapters deal with phylogeny, with the distribution of organisms in past ages according to the conditions of environment, with methods of fossilisation, and with the main characters of the geological periods. In various places the author alludes to the minute research required of modern palæontologists, the investigation of every detail of structure in the face of difficulties that appal the zoologist, the comparison of all stages of growth and of every conceivable variation, the analysis of enormous masses of material, and the tracking of lineages from one horizon to another; and he rightly points out how all this can only be accomplished by the examination of innumerable well-authenticated specimens, and how progress must be continually aided by the increase of our collections.

The remainder of the volume is devoted to Animal Palæontology, which, for the present, only reaches the middle of the Mollusca. This part is by no means so satisfactory; the plan, indeed, is good, but the execution is faulty. In each group, after general remarks and a description of the morphology, the main forms are systematically alluded to, after which their distribution and relationships are treated of. This is right enough, but it is hard to see how much the reader is expected to know already. A person who accepts the term "zoophytes," which our author applies to sponges and echinoderms, would surely be puzzled by the word "polyp" suddenly introduced without explanation under the heading Hydromedusæ. In further support of our condemnation of this part it will only be necessary to quote a few sentences. Thus, the Echinoderms are not only called zoophytes, but their body is said to be "entirely covered with calcified dermal plates." How about most Holothurians? "Les interradiales n'existent pas chez les Crinoides actuels [*Thaumatocrinus* !] : elles se présentent toujours chez les fossiles [*Encrinus* !]." Pinnules are defined as "petits appendices creux"; when they are absent, as in *Cyathocrinus*, covering-plates are said to be present, and then the ventral groove is separated from the canal that contains the axial cord. It is hard to believe that a man who could write such incomprehensible nonsense is a pupil of a leading authority on Echinoderms—Professor Perrier. We will spare the author and our readers from further quotation. The excuse is ready enough. It is impossible nowadays for one man to write

an adequate systematic zoology, even though he confine himself to animals no longer living; the field is far too vast, the literature cannot be coped with, and the pity of it all is that young men fresh from the examination-room can only be taught their own presumption by a fatal experience.

Despite its inevitable faults, we recommend this book to students for the value of its introduction, and for its numerous good illustrations; while, to more advanced workers, it may prove useful as setting forth the views of the French school on many subjects, some here published for the first time. We will only warn the unsuspecting against the specific names at the foot of many of the figures; the misprints, which this book shares with others issued by the same publishers, they will discover for themselves.

F. A. BATHER.

FAUNA UND FLORA DES GOLFES VON NEAPEL: XIX. MONOGRAPHIE; PELAGISCHE COPEPODEN. By Dr. W. Giesbrecht. 4to. Pp. 532, pls. 54. Berlin: Friedländer and Sohn, 1892. Subscription price 50 marks.

THE magnificent series of "Naples Monographs," of which the present is the latest, shows no symptoms of a falling off either in excellence of matter or in the beauty of illustration and printing. Nor do the volumes decrease in size; in fact, they seem to get bulkier with increasing age. Those of us who are interested in the work of the Marine Biological Association's Laboratory at Plymouth naturally feel some envy at the sight of the nineteen volumes which represent the industry of those who are officially connected with the Naples Station, or have enjoyed the great facilities for work there offered. It is greatly to be regretted that the list of subscribers to the funds of the Marine Biological Association is too small to permit of a sufficiently large expenditure of money upon publications. It is rather tiresome, too—the writer is naturally expressing his individual opinion only—that so much purely utilitarian work has to be done, to the partial, but, fortunately, not complete, exclusion of the more interesting lines of Biological enquiry, so admirably developed at Naples.

Dr. Giesbrecht's work is illustrated by fifty-four double plates, of which the first five are devoted to the representation of the living Crustacea with all their natural colours. These plates are so splendid that we feel ourselves unable to praise them adequately without indulging in language of too fulsome a character. The brilliancy of colour often developed in these small creatures is most marvellous; but while some, such as *Sapphirina ovato-lanceolata* (pl. i., fig. 7), exhibit literally all the colours of the rainbow, others are quite plain. We wait anxiously to hear authoritatively the reasons for this display of adornment. The variety of colour even extends to the eggs; they are blue, green, red, olive, or purple—in fact, they are only rivalled in variety by the eggs whose use is peculiar to that season of the year which has just passed. The remaining plates illustrate chiefly a collection of detached appendages of the various species dealt with. The development of these appendages is often quite extraordinary, while the long plumed hairs which they and the body-surface frequently produce are doubtless suggestive of the larval forms of the higher Crustacea. The volume is entirely systematic and faunistic in scope; the anatomy will be treated of in a second part.

Ordnance Survey. Report of the Departmental Committee appointed by the Board of Agriculture to inquire into the present condition of the Ordnance Survey. London: [Parl. Paper C.—6895], 1893. Price 4½d.

There are, we suppose, few readers of this journal who do not take with them upon their perambulations sheets of the one-inch Ordnance Survey maps of the district they are visiting. As, however, there may be some such people, and as it a golden rule that one cannot too often be reminded of a good thing, we call attention to this Blue Book just issued. The report opens with a history of the Ordnance Survey, which may be said to have begun with the measurement of a base-line on Hounslow Heath in 1784. The one-inch to a mile map was commenced in 1797, and continued steadily till 1824, when the whole of the South of England and part of Wales were completed. In 1824 an Irish survey was commenced on a scale of six inches to a mile, and this was extended later to the whole of Scotland and the six northern counties of England; the one-inch maps issued since then having been reduced from those on the larger scale. Since 1855, moreover, the whole of the country has been surveyed anew on a different system, and the result of this work is seen in the "new series one-inch map," so well-known and so valuable to everyone.

After the "history" comes the "methods and processes of the Ordnance Survey," which need not detain us here. The Committee was appointed to consider (1) What steps should be taken to expedite the completion and publication of the new or revised one-inch map (with or without hill-shading) of the British Isles? (2) What permanent arrangements should be made for the continuous revision and speedy publication of the maps (1:500 (towns), 25-inches, 6-inches, and 1-inch scales)? (3) Whether the maps, as at present issued, satisfy the reasonable requirements of the public in regard to style of execution, form, information conveyed, and price; and whether any improvements can be made in the catalogue and indexes? To the first of these questions the answer given is that the continuance of the Temporary Edition ("Advanced Edition") of the maps by photozincography seems desirable.

To the second question, the Committee replies: "The 1-inch map is the one most used by the public for general purposes, both military and civil. We recommend strongly that its revision be carried out at all times independently of that of the larger scales, and that whatever funds are necessary should be provided to carry out these recommendations at as early a date as possible." That the "Cadastral Maps" (5 feet, 10 feet, 25 inches, and 6 inches to the mile), in consequence of the largeness of the scales, rapidly get out of date. "Scarcely any of them have been revised [since 1854], and it is urgently necessary that the advantage of so splendid a work as these maps of Great Britain and Ireland undoubtedly are should not be destroyed for want of a regular system of revision." With regard to the "town maps," they very properly advise that the municipal authorities "should be placed under a statuteable obligation to maintain and correct a copy of that map, showing all alterations in the town inserted in accordance with instructions and regulations to be issued by the Ordnance Survey Department . . . and that failing such proper maintenance, the ordnance surveyors should do what is found to be necessary, and charge the cost to the town." At present this revision is done in a few towns (*e.g.*, Edinburgh) by private publishers, who keep the maps up to date, and actually sell their own correct version to the displacement of the Government Survey.

Considering the enormous number of sheets these "town maps" occupy (13,860), and the small sale, the Committee seems to incline to the view originally put forward by Sir Charles Trevelyan in 1854, that the engraving of "town maps" is unnecessary, and that MS. copies might be supplied at a less cost than that entailed by the engraving and storing of so many plans.

With regard to the third question, the Committee deals with so many criticisms, complaints, and suggestions that it is impossible to quote them here; but they are all fully dealt with in the Report. The most sensible of all, perhaps, is the suggestion "That an edition of the 1-inch map, and of maps on a larger scale on *thin tough* paper be issued," and this the Committee says (p. xxx.) "might probably be serviceable for the 1-inch map." Another criticism, the faulty spelling of names, has been a long-standing grievance, but, as the Committee remarks, a most difficult one to cope with. They give some examples, but hardly any, perhaps, as curious as that of "Silex Bay," near Flamborough Head, the effort, possibly, of some astute surveyor with a smattering of geology, when glancing at the chalk cliff, to take down the local pronunciation of Selwick.

The Committee most truly says, "No country at the present time possesses anything as perfect and complete as our cadastral survey, published by the authority of the Government, and available at a moderate price to every person in the kingdom, showing every plot of ground and every isolated building, and having the new 1-inch map founded on it by the accurate copying power of the photographic lens." Whatever faults exist, this sentence is in the main uncontrovertible, and we sincerely hope that due provision will be made for the continuance and revision of our Ordnance Survey in as liberal a manner as the splendid results already achieved deserve.

A Manual of Bacteriology. By A. B. Griffiths, Ph.D., F.R.S.E., F.C.S. London: William Heinemann, 1893. Price 7s. 6d.

There is a suggestion of book-making about this volume. The frontispiece is a view of the outside of the Pasteur Institute; there is a ground plan and a view of the interior of the Edinburgh Bacteriological laboratory; a representation of a Zeiss' microscope; of microphotographic apparatus; microtomes; needles and knives, and much other delectable matter. The drawings of microbes themselves are not numerous or particularly clear. The suggestion of collation is by no means dispelled on reading. A fair account of microbes and the various methods of investigating them is given, but there seems no special reason why Dr. Griffiths rather than anyone else should have written the book. No doubt it is intended to be more elementary, but we miss the breadth of view and clearness of exposition to be found in Dr. Sims Woodhead's volume on "Bacteria and their Products." The publisher is, however, to be congratulated on the excellent get-up of the book.

Birds of Germany. "Deutschland's nützliche und schädliche Vogel." By Dr. Hermann Fürst. 8vo text, and fol. coloured pls. Pt. i. Berlin: P. Parey, 1893.

As a perfect marvel of cheapness, combined with the highest style of artistic excellence, this work, of which the first part is before us, can have but few if any equals; and as most of the birds of Germany are

common to our own country, it ought to command a large sale here, as well as abroad. The special object of the work is to enable all such as are engaged in rural pursuits to recognise the ordinary birds with which they may meet, and, at the same time, to distinguish between those which are harmful and those which are useful either to the agriculturist, the gardener, or the gamekeeper. With this object, it has been considered of prime importance that the illustrations should be on such a scale as to render the task of identifying a bird as easy as possible without the trouble of wading through descriptions. Accordingly, it is announced that the smaller and medium-sized species are to be figured of the natural size, while the larger kinds are to be reduced by one-half. Each part is to comprise four double folio plates, lithographed in colours, and accompanied by a sheet of 8vo text; the price of each part being three shillings (marks). The work is to be completed in eight parts; and if the execution of the plates is kept up to the standard of those in the first part, it will place trustworthy and artistic likenesses of a large number of European birds within reach of all, at an exceedingly low price. R. L.

L'AQUARIUM D'EAU DOUCE. By H. Coupin. (Bibliothèque des connaisances utiles.) 16mo. Pp. 348, 228 figures. Paris: Ballière et Fils, 1893. Price 4 fr.

THIS useful addition to Ballière's Library is written for young naturalists and those who take a casual interest in natural objects. The author treats of the aquarium and its forms, of water and its aëration, of the proper plants and their effect on the purity of the water, of methods of capture, and of the various groups of animals, giving a sketch of the life-history and other matters interesting for observation. The book is copiously illustrated, and although the figures are in some instances rather crude, they will be of considerable use to those for whom the book is intended. We are glad to see the footnote on p. 91 regarding the reversible Hydra.

CATALOGUE OF THE BRITISH ECHINODERMS IN THE BRITISH MUSEUM (NATURAL HISTORY). By F. Jeffrey Bell. London, 1892.

A CATALOGUE is hardly expected to furnish interesting reading; one does not exactly look into the British Museum publications of this kind with any expectation of finding easily assimilable tit-bits of zoological information; and yet this rule, like many others, is not without its exceptions. Dr. George Johnston's contribution to the series is full of highly readable and instructive notes concerning the "non-parasitical worms." Mr. Bell's catalogue is written on the plan of some of the more recently-issued volumes; that is to say, it is moderately learned and very arid, but, unlike many of them, it is restricted to an account of the inhabitants of the shores of Great Britain and Ireland. "One of its objects," writes the author, "is to supply the student of the British Marine Fauna with a handbook"—to the Echinoderms of our shores. Dr. Günther hopes in the preface that the study of Echinoderms will be encouraged by a perusal of this volume. We think, however, that the public, to whom the catalogue is addressed, will come to the conclusion that the study of the Echinoderms is fraught with too much contentious matter, and that it is as thorny as are the objects with

which it deals; for one quarter of the author's preface is devoted to an attack upon Mr. Sladen's "Challenger" volume upon the Starfishes. We are not concerned with the issue of this dispute, though, incidentally, we may remark that the opinions of a gentleman who has made material additions to the morphology of the Echinoderms are not treated with the respect that they should have met with at the hands of the author of the catalogue before us. The bracketed remarks in the following phrase strike us as not being at all in place. Mr. Bell says that Mr. Sladen repeatedly expresses "views for which he does not give (I do not say, does not possess) adequate reasons." The bellicose tone which is adopted throughout is not suited to the nature of the publication; and we desire to protest against its use in an official catalogue.

As to the catalogue itself, the list of genera and species is preceded by some "Introductory Remarks," occupying ten pages, and consisting of a sketch of the anatomy of the group. This sketch can hardly serve any useful purpose. It cannot be pretended that it is an adequate account of the structure of the Echinoderms; a more detailed and illustrated description of the hard parts alone would have been useful, as they are principally used for classification purposes; the catalogue is written by a systematist for systematists, and we cannot see why he should have attempted anything more ambitious.

In fairness to the author, we ought to say that the actual catalogue itself seems carefully and conscientiously done; he is here in his natural element; and there is a freedom from misprints which indicates much laborious work on the part of the author and (we presume) the editor. We cannot be too thankful that persons exist who are capable of doing and willing to do this necessary but uninteresting work for us.

The Earth's History. An introduction to Modern Geology. By R. D. Roberts, M.A., D.Sc. [University Extension Manuals.] Crown 8vo. Pp. 365, with 8 plates and 51 illustrations in the text. London: John Murray, 1893. Price 5s.

Under the above somewhat ambitious title, Dr. Roberts adds one more to the numerous geological text-books. The volume is nicely got up, and contains several useful maps, printed in colours; but beyond this we cannot praise the book, for it contains only the well-known materials worked up again. One does not, of course, expect much originality in a text-book, but the student has a right to ask that the author shall make a good selection, and arrange the matter systematically.

Handbook of the Irideæ. By J. G. Baker, F.R.S., F.L.S. 8vo. Pp. 247. London: George Bell & Sons, 1892. Price 5s.

We gladly welcome another addition to the valuable series of monographs by Mr. J. G. Baker, of Kew. The present volume is the fourth of a series devoted to certain groups of plants that enter largely into horticulture. To many it will be the most interesting of the series, for it deals with such handsome and well-known genera as Iris, Crocus, Ixia, and Gladiolus, besides a host of less familiar forms, unknown except to the systematic botanist.

Few, even of the professional gardeners, will have any idea of the wealth and variety to be found in this group of plants. Iris, for instance, has no fewer than 161 species, Crocus has 66 species, Ixia 24, and Gladiolus as many as 132. Plants of this order have, usually, such large and showy flowers, and many of them cross so freely, that they are particularly adapted for experiments on cross-fertilisation. For this reason, as well as for their beauty, we should like to see the group more fully represented in our gardens and green-houses. Mr. Baker's "Handbook," we may observe, is in English. The author gives, besides the technical descriptions and habitat, full references to the earlier authorities, and, in the case of rare forms, he mentions the original discoverer.

Those who work upon the Tertiary Fossils of the United States will be gratified to hear that Dr. W. H. Dall has successfully grappled with the difficult task of determining the dates of publication of Conrad's books—"The Fossils of the Tertiary Formation" and the "Medial Tertiary." These books were issued in separate parts, all of which are now exceedingly scarce. Dr. Dall has given in his paper (*Bull. Phil. Soc. Washington*, vol. xii., 1893, pp. 215–240) full and exact descriptions of these separate parts and their contents, and has thus rendered a service to conchologists, after an amount of labour known to few. The paper gives an excellent idea of the difficulties met with in determining and establishing an exact nomenclature when dealing with publications the dates and history of which are involved and obscure. The author hopes to be able shortly to reprint both of Conrad's works. Mr. G. D. Harris, of the Smithsonian Institution, is publishing a reprint of "Fossil Shells of the Tertiary Formations," at three dollars a copy, and invites subscriptions.

We have received the first fascicule of Fernand Priem's "La Terre" (Ballière, Paris), a book which deals with Seas and Continents, Physical Geography, Geology, and Mineralogy. This is, of course, a more or less popular account of the subjects mentioned, but the numerous and excellent engravings, which appear to be chiefly taken from photographs, make it an exceptionally useful book for the student. It will be completed in four parts, at two francs fifty centimes each, and will contain 700 figures.

Senhor Cazurro concludes his elaborate study of the actinian *Anemonia sulcata* in the third part of volume xxi. of the *Anales Soc. Españ. Hist. Nat.* The structure of this form is worked out in the most elaborate detail, and important light has thus been thrown on the group. In the same number, Westerland prints a "Faunula Molluscorum Hispalensis," and Girard a paper on "Céphalopodes des côtes de l'Espagne."

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

We learn that the Plymouth Marine Biological Station has lost the services of Mr. Calderwood, who has resigned.

Dr. Preuss, at the instance of the German Foreign Society, has gone to Victoria, in the Cameroons, as director of the Botanical Gardens. (*Bot. Centralblatt*).

Sir Henry Tichborne, who was attached to the Villiers Expedition for the exploration of Lake Rudolph, has returned to England in order to fulfil his duties as Sheriff.

Dr. William King, Director of the Geological Survey of India, has been granted an extension of service to July, 1894, notwithstanding the working of the 55 years' service rule.

Dr. D. Riva who took part in Professor Schweinfurth's last expedition to Eritrea, has undertaken a journey of exploration in the Ginba River district, East Africa. (*Bot. Centralblatt.*)

The fourth Report of the Epsom College Natural History Society, for 1892 has just appeared, and we see that the study of Natural Science is well appreciated in the school. The field-notes relate principally to dates of first bloom of flowers, Lepidoptera, first appearance of birds and dates of nesting, and meteorological observations.

Among the additions to the Herbarium of the Missouri Botanical Garden during 1892, we find mention of about 3,000 duplicates from the Herbarium of the late John Ball. The institution is also rejoicing in the donation by Dr. Sturtevant of his entire botanical library, which, according to the *Botanical Gazette*, "is undoubtedly the most complete and valuable American collection of pre-Linnæan botanical books."

On Monday, 27th February, the "Malacological Society of London" was founded, at a meeting held, by the kind permission of Mr. G. F. Harris, at 67 Chancery Lane. Mr. W. H. Hudleston took the chair, and the meeting elected Dr. Henry Woodward as the first president, Messrs. Hudleston, Melville, Godwin-Austen, and E. A. Smith as Vice-Presidents, Mr. E. R. Sykes as Secretary, Mr. G. F. Harris as Treasurer, and the following as its first council:—H. W. Burrows, J. H. Ponsonby, G. C. Crick, W. Crouch, Rev. A. M. Norman, B. B. Woodward and G. B. Sowerby.

A LIST of seventy names was read by the Secretary of those who had expressed their willingness to join the Society, and it was resolved that they be the original members. The annual subscription was fixed at half-a-guinea, and the entrance fee at the same sum; all those joining before December 31, 1893, will be elected by ballot in the customary manner, but will be exempt from the entrance fee.

THE meetings of the new Society will be held on the second Friday in each month (November to June) at 8 p.m., and, for the present, Mr. Harris has courteously permitted the Society to meet at 67 Chancery Lane. The Council as at present appointed will draw up the rules of the Society, which will be presented to the first General Meeting, to be held on April 14. Letters to the Secretary (Mr. E. R. Sykes) should be addressed to 13 Doughty Street, London, W.C.

THE objects of the society will be to study Malacology in all its branches, both recent and fossil, anatomical and skeletal, and if we may judge from the list of names furnished to us as founders of the society, has a great future before it. We hope, however, that it will do real scientific work, and leave the publication of local lists and small matters of that kind to the field clubs.

THE Geologists' Association will start for Norwich on Thursday evening, March 30. On Friday the members will visit the Norwich Crag and Chalk at Bramerton and Thorpe, on Saturday the cliffs at Mundesley, Trimingham, and Overstrand and on Monday those from Cromer to Sherringham and Weybourn. On Tuesday, those who have the time still free will proceed to Lowestoft and visit the Pakefield Cliffs.

WE have received from Professor Jules Marcou a pamphlet, entitled "A Little More Light on the United States Geological Survey," containing bitter personal attacks on many of the geologists. We do not profess to understand the rights of these personal disputes, but are sorry to see, from various papers that have lately reached us, that party feeling is affecting the value of much of the geological work done in the United States, both by the official geologists and those outside. Some comments on the work of the United States Geological Survey will be found in our last volume (p. 644).

CIRCULARS from the World's Fair at Chicago arrive with startling rapidity. The latest we have received comes from the "General Division of African Ethnology," and unfolds a gigantic programme of work to be accomplished, dealing with Geography, History, Arts, Language and Literature, Religion, Natural Science, and Social and Political Science. Natural Science, of course, interests us the most, and we read that the following papers are promised:—"Astronomy," by W. W. Payne; "Structure of Africa and its Geological Systems," by James Geikie (invited); "Economic Geology of Africa," by Jos. Thomson (invited); "African Anthropology and Ethnology," by Heli Chatelain; "African Flora and Fauna, with Economic Botany and Zoology," by G. Schweinfurth and E. Holub (both invited). What the word "invited" means we are not told, but we only hope the desires of the promoters will be realised. There is a long and important list of "Advisory Council" printed at the end, and among those who are representatives of the different countries of the world, we read "H. M. Stanley, representing Humanity," and this entry comes first.

A SYSTEMATIC and alphabetical index of new species of North American flowering plants and ferns published in 1892 is in preparation at the United States National Herbarium. What a boon to systematists if all national Herbaria would follow this example!

A PRELIMINARY circular announces the organisation of a botanical survey of Nebraska, to be conducted by the Botanical Seminar of the State University at the expense of the members. Systematic botany evidently holds a far higher position across the Atlantic than in our English Universities.

PROFESSOR HERMANN CREDNER, of Leipzig, has issued a pamphlet, in English, explaining the methods and rate of progress in the Geological Survey of Saxony, of which he is Director. We observe that the greater part of the maps are already published, and that two or three years hence we shall see the completion of the Survey on the scale of 1 : 25,000.

ACCORDING to the *Botanical Gazette*, Professor Bolly, of the State University at Fargo, will exhibit at the World's Fair jars containing the tubercle-bearing roots of about forty species of North Dakota leguminous plants. The monumental work by Engler and Prantl (the progress of which, by the way, has somewhat slowed down of late), "Die Natürlichen-Pflanzenfamilien," will be specially displayed by the publisher, W. Engelmann, of Leipzig.

FROM the same journal we learn that Beloit College has recently dedicated a new building, known as "Pearson's Hall of Science," in which admirably arranged botanical laboratories find a conspicuous place.

PROFESSOR BURDON SANDERSON, F.R.S., has been nominated to preside at the Nottingham meeting of the British Association. The following gentlemen have also been nominated to act as presidents of sections at Nottingham:—Section A, Mathematical and Physical Science, Professor Clifton, F.R.S.; Section B, Chemistry and Mineralogy, Professor J. Emerson Reynolds, F.R.S.; Section C, Geology, Mr. J. J. H. Teall, F.R.S.; Section D, Biology, the Rev. Canon Tristram, F.R.S.; Section E, Geography, Mr. Henry Seebohm, Sec. R.G.S.; Section F, Economic Science and Statistics, Professor J. S. Nicholson; Section G, Mechanical Science, Mr. Jeremiah Head; and Section H, Anthropology, Dr. Robert Munro.

Indian Engineering for February 18th has some remarks on "The Directorship of the Indian Geological Survey," from which we reprint the following:—"The Geological Survey has a lot of stiff geology before it yet in India which should be cleared off; though, as a matter of fact, the present director has been obliged to keep this geological progress back, in deference to the wishes of the Government to have mineral areas more thoroughly explored, and this doubtless goes against his reputation with his brother Geological Directors in Europe and America." The writer does not at all like the idea of "amalgamating the small scientific departments under a covenanted civilian," and prays, in view of such a contingency, for a special Mining Department. He goes on to say "The Geological Survey has been very judiciously kept away from the latter [gold and other mines]; though we are not so satisfied about the Department being kept, as appears to be the general policy, from making a proper *survey* of the gold and other mineral areas."

THE *Report of the Meeting of the British Association*, held in Edinburgh last year, has just been issued. Among the reports of the Committees we notice the following, which may be of interest to our readers:—12th on the "Earthquake and Volcanic Phenomena of Japan"; 19th on the "Rate of Increase of Underground Temperature downwards in various localities of Dry Land and under Water"; 18th on the "Circulation of Underground Waters"; 20th on "Erratic Blocks"; 3rd of the Committee to arrange for the "Collection, Preservation, and Systematic Registration of Photographs of Geological Interest in the United Kingdom"; final

report on "Cretaceous Polyzoa"; "Volcanic Phenomena of Vesuvius"; Zoological Station at Naples"; 5th on the "Zoology and Botany of the West India Islands"; 2nd on "Biological Association of Plymouth"; 6th on "Botanical Laboratory at Peradeniya, Ceylon"; "Teaching of Science in Elementary Schools."

The papers read in the various Sections are mostly published in short abstract, and have appeared in a more complete form elsewhere. Amongst the geological papers of interest, and containing original observations, we note one by Mr Peach "On a Widespread Radiolarian Chert of Arenig Age, from the Southern Uplands of Scotland," and another by Mr. Horne, "On the Contact Metamorphism of the Radiolarian Chert in the Lower Silurian Rocks along the Margin of the Loch Doon Granite." Mr. Dugald Bell criticises the "Alleged Proofs of Submergence in Scotland during the Glacial Epoch"; Mr. Clement Reid gives a list of the "Fossil Arctic Plants found near Edinburgh"; and Messrs. Peach and Horne write on "The Ice-Sheet in the North-West Highlands during the Maximum Glaciation," and on a "Bone Cave in the Cambrian Limestone in Assynt, Sutherlandshire." The remains found in the cave at Assynt seem to be of Recent or Neolithic date.

In the section for Biology, the chief botanical papers are Dr. Goebel's "On the simplest form of Mosses (*Buxbaumia*)"; George Murray's "On a comparison of the Marine Floras of the warm Atlantic and the Indian Ocean"; H. W. T. Wager, "On the structure of *Cystopus candidus*," the parasitic fungus of the shepherd's purse; and Gustav Mann's, on "The Embryo-sac of Angiosperms." The papers of most interest in Zoology are those of E. W. Carlier, "On the structure of the so-called Hibernating Gland in the Hedgehog"; and "On the Skin of the Hedgehog"; of Gustav Fritsch, "On the origin of the Electric Nerves in the *Torpedo*, *Gymnotus*, *Mormyrus*, and *Malapterurus*. Several interesting economic papers on Fisheries—Calderwood, "On the Destruction of Immature Fish"; Holt, "On the Relation of Size to Sexual Maturity,' and "On the Destruction of Immature Fish in the North Sea," and Cunningham "On the Protection of Immature Fish." Of the purely Physiological papers, the most interesting are—Marcus Hartog, "On Rabl's Doctrine of the Personality of the Segments of the Nucleus," and Weismann's "'Idant' Theory of Heredity"; and Gustav Mann, "On the Origin of Sex,"

A Guide to Sowerby's Models of English Fungi in the Department of Botany has been published by the Trustees of the British Museum. It has been prepared by Mr. Worthington Smith, who, a few years ago, restored the models to their original colour. The little book of 82 pages, with 93 illustrations, costs only fourpence, and deserves particular notice from the fact that it is not merely a guide to the models, but to the larger forms of our native fungi. All the prominent genera of the *Hymenomycetes*, *Gasteromycetes*, and *Ascomycetes*—prominent from their size—are represented here in their typical species with adequate descriptions, and a woodcut for each genus. The so-called microscopic forms are not dealt with, and since their study is not by any means so popular as that of the larger fungi, there will be no popular regrets on this head. The search for, naming, and drawing of mushrooms and toadstools is a very favourite pastime, apart from its scientific interest, among large numbers of leisured country folks, as well as the Saturday afternoon naturalists, and the issue of this little book for fourpence, with its well-executed figures and simple descriptions, is sure to be popular, apart from its interest as a guide to the models. In fact it is much more likely to be utilised away from the models than in presence of them. Mr. Worthington Smith's magnificent series of drawings exhibited beside the models is another attraction to the botanical gallery for students of Fungi, and the authorities are to be congratulated on the exhibition, as well as on the production of this Guide, which bears all the marks of honest work.

OBITUARY.

KARL AUGUST LOSSEN.

DIED FEBRUARY 24, 1893.

SCIENCE has sustained a severe loss in the death, on February 24, of Dr. Karl August Lossen, Professor of Geology at the School of Mines and at the University of Berlin, and chief Geologist of the Prussian Survey.

Dr. Lossen was an enthusiastic field geologist and an able petrologist. Most of his work was done in the Hartz, and his well-known map of that district is remarkable both for its accuracy and for the minuteness of the detail. He was one of the first to establish the immense importance of dynamic agencies in modifying the structure and composition of both igneous and sedimentary rocks, and he clearly recognised that the principles which he had established by detailed work in his own area were applicable to all parts of the Hercynian range in its course through Europe, from the West of England to the Sudetes. His early papers will be found in the *Zeitschift der deutschen geologischen Gesellschaft*, between the years 1864 and 1880. His later and, in some respects, most important work was published in the *Jahrbuch der königlich preussichen geologischen Landesanstalt*, and in the detailed memoirs on the separate sheets issued by the Prussian Geological Survey (1 : 25,000).

The great importance of his work has failed to attract the general attention which it deserves in consequence of his extremely involved literary style—a style which was probably due in part to his unfortunate deafness. All those who had the good fortune to meet him speak with enthusiasm of his charming personal character, and of his extreme readiness to communicate any information which he possessed. He was a Foreign Correspondent of the Geological Society of London.

WE have also to announce the death of Professor Schaaffhausen, of Bonn, whose name was prominently before the scientific world some thirty years ago in connection with the famous Neanderthal Skull. In 1880 he visited this country, bringing with him the original skull, which he exhibited and described at the Swansea meeting of the British Association. He was born in 1816.

We learn with regret that Professor Karl Prantl died on February 24, at Breslau, where he was Professor of Botany and Director of the Botanical Gardens. He is, perhaps, best known in this country for his "Lehrbuch," of which an edited translation by Professor Vines has been widely used among students, who, while in need of a modern text-book, found that of Sachs somewhat too ponderous. He was also joint editor, with Professor Engler, of the valuable "Pflanzenfamilien," still in progress of issue, and sole editor of *Hedwigia*, the organ of those who love mosses. Professor Prantl was also the author of some Researches on the Morphology of Vascular Cryptogams, and an "Exkursionsflora fur das konigreich Bayern." Last year he started a new publication, entitled "Arbeiten aus dem Kon. Bot. Garten zu Breslau."

DEVONSHIRE has lost an enthusiastic and observant naturalist in the person of Edward Parfitt. Born near Norwich in 1820, the son of a gardener, he had from his earliest youth a passion for studying life of all kinds, which led him to go to sea in order to get some acquaintance with foreign animals. Wrecked near the Cape, he was obliged to make a long stay which increased his taste for Botany and Entomology, and allowed him to make a collection. On his return to England he devoted himself to Horticulture, and went to Devon about 1846. Since then Parfitt worked on the Natural History of the County, published numerous local papers, and has left a MS. on the Devon Fungi in 12 volumes, illustrated by 1530 plates, drawn and painted by himself. He was Librarian to the Devon and Exeter Institution for 32 years. Parfitt was entirely a self-made man, and Devon has lost a naturalist she could ill spare. He died on January 15.

TO CORRESPONDENTS.

All communications for the Editor *to be addressed to the* Editorial Offices, *now removed to* 5 John Street, Bedford Row, London, W.C.

All communications for the Publishers *to be addressed to* Macmillan & Co., 29 *Bedford Street, Strand, London, W.C.*

All Advertisements *to be forwarded to the sole agents,* John Haddon & Co., *Bouverie House, Salisbury Square, Fleet Street, London, E.C.*

ERRATUM.

P. 207, line 8, for "elder" read "alder."